



TinkerPlots Help

Version 1.0



Key Curriculum Press

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Introduction

TinkerPlots™ Dynamic Data Exploration is a data analysis program designed specifically for use by students in grades 4–8. With it, students can enter data they collect themselves or find on the Internet and can create their own graphs or tables of these data. They can also use TinkerPlots to produce reports that include these graphs, along with text that explains their findings and even photos they take or locate on the Internet.

What makes TinkerPlots different from any other “graphing” or spreadsheet program is that, with TinkerPlots, students actually design their own graphs. This gives them a sense of being in control of what they produce.

Like a word-processing or spreadsheet program, TinkerPlots is a *general* tool that teachers and students alike will find useful across a large range of subject matter. It comes with a variety of ready-to-analyze data collections, drawn from topics including mathematics, science, history, geography, health studies, sports, and more.

TinkerPlots Help is a look-up guide, not a tutorial. It answers your questions about how to use TinkerPlots to accomplish specific tasks. The best first introduction to TinkerPlots is a five-minute movie called *TinkerPlots Basics*. You can view this movie by choosing [TinkerPlots Movies](#) from the **Help** menu and then **TinkerPlots Basics** from the Movies page. After you’ve watched this short introduction, you’ll be ready to use TinkerPlots for most basic tasks. The Movies page also contains several other short movies that cover various topics in more depth. But we’d recommend viewing these after you’ve had a chance to use the program for a while. You’ll also find that you can discover many capabilities by just trying things out on your own.

We also recommend that you read the section [TinkerPlots Terms](#). Some of these terms, such as [fully separated attribute](#), are unique to TinkerPlots.

The Relationship of TinkerPlots to Fathom

TinkerPlots shares many features with the software package [Fathom Dynamic Data™](#). Fathom is a data analysis program designed for high school and introductory college courses. Those of you who are familiar with Fathom will recognize many features the two programs share. The case table in TinkerPlots is, in fact, nearly identical with Fathom’s case table. Text boxes, sliders, and the formula editor are also objects that TinkerPlots and Fathom have in common. Functions such as printing, exporting, and saving are all Fathom routines used by TinkerPlots.

TinkerPlots Terms

Collection

A *collection* is a set of data about several cases. For example, the collection **Cats.tp**, which comes with TinkerPlots, contains information on 24 cats.

Case

A *case* is the basic unit of a data set or collection. For example, in a collection of cats, each cat is a case. In a collection about different countries of the world, each country is a case. Information about each case is recorded on one card in the data cards. Each case also has a case icon in a TinkerPlots plot.

Attribute

Cases have *attributes* (also known as *variables*). For example, a collection about cats might include, for each cat, the attributes *Gender*, *Length*, and *Fur_Color*. Attribute names for a collection are listed on the left side of each data card.

Value

Each case has a *value* for each attribute. A particular cat might have the values “Male” for *Gender*, “21” for *Length*, and “Black” for *Fur_Color*. The value appears directly to the right of the attribute name in the data cards.

Numeric Attribute

A *numeric attribute*, such as *Length* or *Age*, has numbers for values. You can plot numeric attributes on a number line and find their mean.

Category Attribute

A *category attribute* has values that are letters or words. *Gender* is a category attribute with the possible values “Male” and “Female.” *Fur_Color* is also a category attribute with values “Black,” “White,” “Black_and_White,” and so forth. You can graph category attributes by separating cases into their different categories. Unlike numeric attributes, you can’t plot category attributes on a number line or find their mean.

Attribute Color Bar

To the left of each attribute name in the data cards is an *attribute color bar* that shows that attribute’s color scheme. You can modify an attribute’s color scheme by double-clicking on its color bar.

Selected Attribute

This is the attribute currently selected in the data cards. When an attribute is selected, a gray rectangle appears around its name in the data cards, and the case icons in the plot are colored with that attribute’s color scheme.

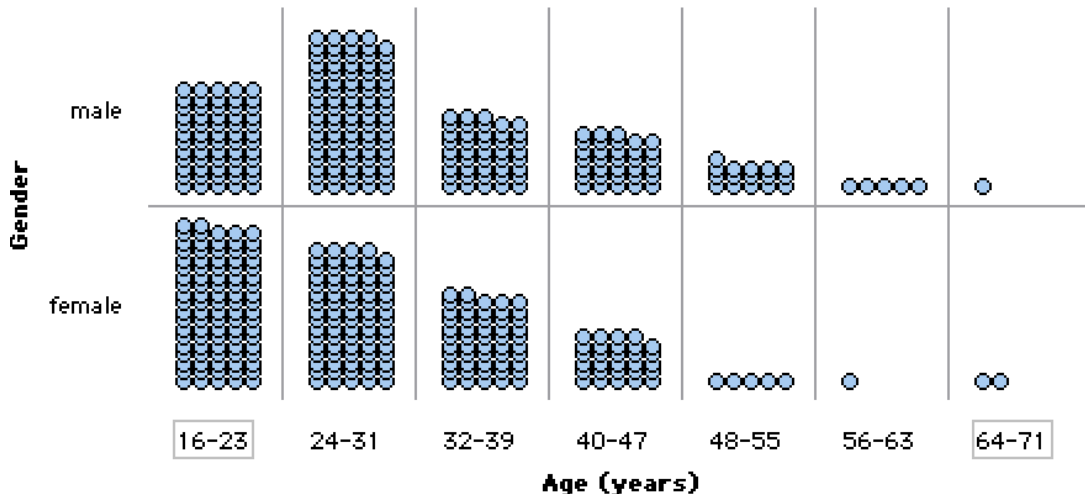
Plot Color

When you select an attribute in the data cards, the case icons in the plot take on that attribute’s color scheme. For numeric attributes such as *Age*, the case icons are colored with a gradient—different shades of red, for example. The cases with the largest values have the darkest

hue (dark red, for example), while cases with the smallest values are near white. For category attributes, case icons with different values are colored with distinct hues, such as red, green, and purple.

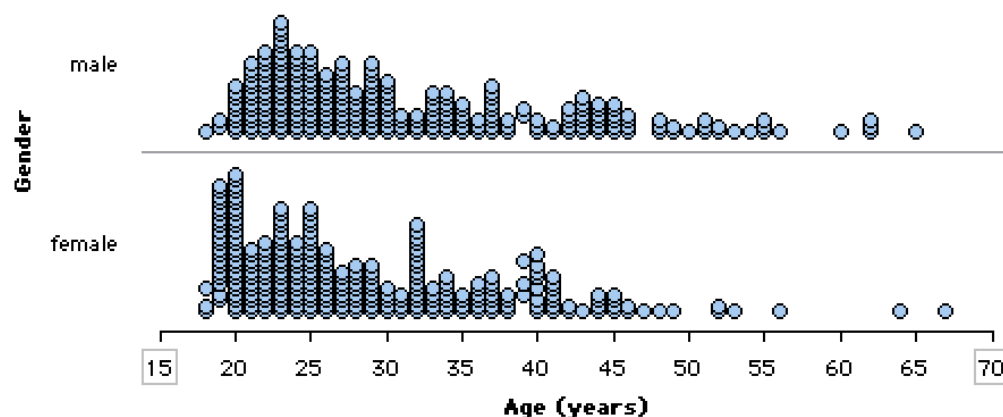
Bins

Bins are divisions in plots that contain all cases of a certain type. Bins are separated by light-gray bin lines. You might want to have “males” and “females” in separate bins, for example. For a numeric attribute such as *Age*, you might place people 16–23 years old in one bin, 24–31 in the next, 32–39 in the next, and so on.



Fully Separated Attribute

When in a plot you separate an attribute into as many bins as possible, the attribute is *fully separated*. When a numeric attribute such as *Age* is fully separated, the axis appears as a continuous number line and there are no visible bin lines.



Excluded Cases

Often a case will be missing a value for one attribute. A cat’s age, for example, might have been left blank because it was a stray and no one knew its age. In this instance, when the attribute *Age* is selected, the case icon for that cat will be colored gray. If you put *Age* on a plot axis, the case’s

icon will move to the right side of the plot window into the *excluded cases* stack. Also, suppose you wanted your graph to show only those cats that were 2 years and older. You could set the minimum value of the *Age* axis at 2, which would cause all cats younger than 2 to move into the excluded cases stack.

Case Icon Type

There are several *case icon types* you can choose for a TinkerPlots graph, including circle (the default), square, value bar, and fuse rectangular. The image icon type allows you to make a graph with icons resembling cats, for example.

Attribute Formula

You can use an *attribute formula* to compute the values of an attribute. For example, you could use a formula to convert heights measured in inches to heights measured in centimeters, or to divide the attribute *Income* of various countries by the attribute *Population* to make a new attribute, *Income_per_Person*.

Getting Started

Here we provide information about installing on multiple computers, getting technical support, and other basic details.

Install on Multiple Computers

There are two possible configurations for installing a TinkerPlots multi-user edition: Install on each computer or install on a network server. (The type of license you bought specifies how many computers you have permission either to install or to run TinkerPlots on.) It is less work to install and upgrade only on a server, though it will slow performance (by how much will vary depending on the speed of your computers).

Installation is similar for all: Insert the CD-ROM, double-click the installer, and follow the instructions on the screen. At the end, you have a choice of restarting or not restarting the computer.

To Install on Each Computer

Use the TinkerPlots CD-ROM to install TinkerPlots onto each computer for which you are licensed.

Insert the CD-ROM into a computer's CD drive, open it, double-click the installer, follow the instructions on the screen, and restart when you're through.

Or,

Use the CD-ROM in the server's CD drive to install onto each machine for which you are licensed (this is faster than the previous method, because you can install on more than one machine simultaneously).

Insert the CD-ROM into the server's CD drive and give sharing privileges for each machine. From each computer, access the server's CD drive, double-click the installer, follow the instructions on the screen, and restart when you're through.

To Install on the Server

Insert the CD-ROM into the server's drive, open it, double-click the installer, and follow the instructions on the screen. At the end, you will be asked whether you want to restart the computer (your choice).

Make sure the TinkerPlots folder is shared to each computer for which you are licensed, by whatever method you usually use to share networked software.

You may want to put shortcuts or aliases to TinkerPlots on each networked computer.

Note: All installed sample documents are locked so that students cannot easily save over them. When students try to save, they will be prompted with a **Save As** dialog box. They must rename or move the file in order to complete the save.

Open a Sample Document

TinkerPlots comes with several sample data sets. To open one of these,

1. Open the folder **Data and Demos** and then one of the subfolders.
2. Double-click one of the TinkerPlots files (these have the suffix **.tp**).

Or, with TinkerPlots running,

1. Choose **Open** from the **File** menu.
2. Locate the folder **Data and Demos** and then one of the subfolders.
3. Choose the file you want and click **Open**.

Get Technical Support

When something goes wrong and you need support, you can

- Check the TinkerPlots Web site at <http://www.keypress.com/tinkerplots>. You will find answers to frequently asked questions and the latest updates to the program. You can also check for updates by choosing **Check for Updates** from the **Help** menu.
- Fill out an online technical support form at the TinkerPlots Web site.
- Call our technical support line at Key Curriculum Press, 510-595-7000. We can be most helpful to you if you are sitting in front of a computer with TinkerPlots running.

Save and Back Up Your Work

No computer system is infallible. Your time is valuable. If you have done a lot of work to enter data or carry out a brilliant analysis, save your work. Save early. Save often. And then make an extra copy just in case.

Undo and Redo

TinkerPlots supports (almost) unlimited undo and redo. This means that you can backtrack several steps to return to a previous plot or state. Choose **Undo** from the **Edit** menu or press **Ctrl+Z** (Win) **Command+Z** (Mac) to undo the previous action. Choose **Redo** to return to the most recently undone state: **Ctrl+R** (Win) **Command+R** (Mac).

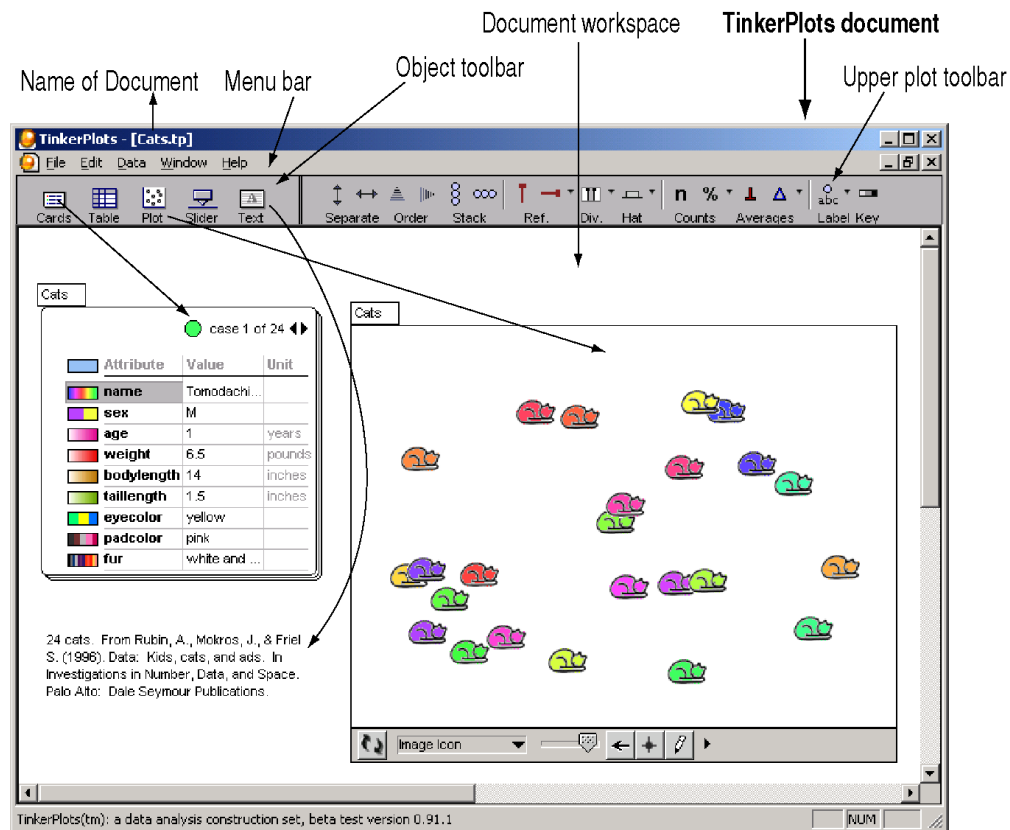
Working with a Document

A TinkerPlots document is a scrollable page that may contain many different objects that show different views of the same collection of data, several graphs, for example. Students can use TinkerPlots not only to analyze data, but also to write a brief report. A report might include several graphs and even pictures. (For a sample report, see the file **Backpack Report.tp** in the **Data and Demos | Demos** folder.)

There are six different types of objects you can include in a document: data cards, case tables, plots, sliders, text, and pictures. To learn more about these objects, see [TinkerPlots Objects](#).

Parts of a Document

This figure shows a TinkerPlots document, which includes a plot on the right and a stack of data cards on the left.



Create a New Document

Choose **New** from the **File** menu.

Place an Object in a Document, Move It, and Resize It

- To place an object in a document, drag the object from the object toolbar (upper-left corner of the window) and drop it where you want it in the document.
- To move an object, grab the top bar of the object and drag it to a new location.
- To resize an object, grab it by a side, a corner, or by its bottom edge, and drag to the desired size.

Duplicate an Object

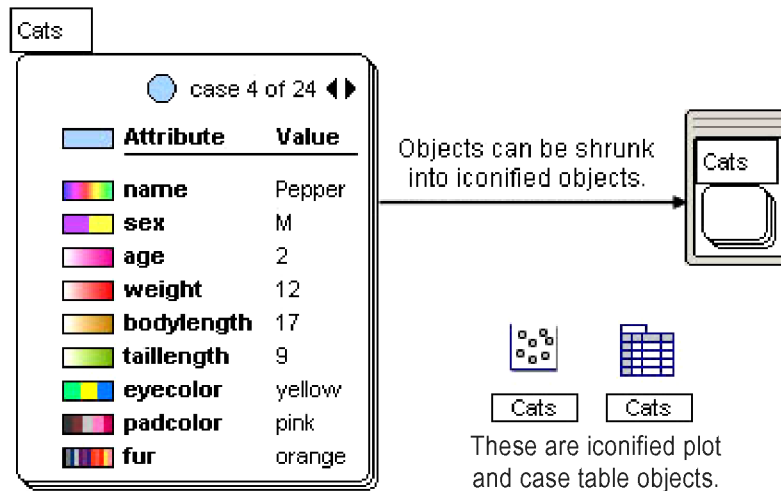
Duplicating an object is especially useful when you want to make a new graph based on an existing one (for instance, when you want to create two versions of a graph, one with males only and one with females only). To duplicate an object,

1. Select the object (click on it).
2. Choose **Duplicate Object** from the **Edit** menu.

Iconify an Object and Get It Back Again

If you make an object very small, it will become an icon. This can help save space in your document. To expand an iconified object, drag a corner or an edge to make it larger.

You can drag icons by their top bars or by their centers.



View an Object in a Separate Window

Sometimes you want to see one object without having to shrink everything else. You can open that object in its own window, which floats on top of the document.

1. Select the object by clicking on it.
2. Choose **View In Window** from the **Window** menu.

The object now exists in its own floating window as well as in the document.

Click the object's close box when you're done with it.

Working with Collections

In TinkerPlots, data sets, or collections, are stored in a stack of data cards. With data cards you can see one case at a time, add or change data, drag attributes into plots, and change the color scheme of attributes. You can use other objects, namely case tables and plots, to see your data displayed in other ways.

Open a TinkerPlots Document

TinkerPlots comes with several collections ready to analyze. To open one of these,

1. Double-click a TinkerPlots document (these have the suffix **.tp**). This will open that document and, if necessary, start up TinkerPlots.

Or, with TinkerPlots running,

1. Choose **Open** from the **File** menu.
2. Navigate to the **Data and Demos** folder and to one of the subfolders. Choose the document you want and click **Open**.

TinkerPlots will also open any Fathom-format files (files with the suffix **.ftm**). When you open a Fathom document in TinkerPlots, you won't be able to see some of the Fathom objects (such as Fathom graphs), but the data will be there. (To learn more about the relation between Fathom and TinkerPlots, see [The Relationship of TinkerPlots to Fathom](#).)

Make a New Collection

You can enter your own data into TinkerPlots using either [data cards](#) or a [case table](#).

Enter Data into Data Cards

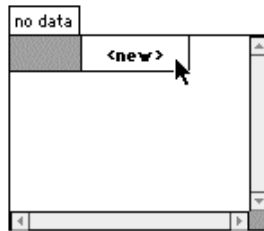
1. Choose **New** from the **File** menu to open a new TinkerPlots document.
2. Drag a stack of [data cards](#) from the object toolbar into the document. This creates an empty stack of data cards to hold your data.
3. In the data cards, double-click the cell labeled **<new attribute>**. Type an attribute name, then press **Enter**. A new row will appear below the attribute you just named, where you can enter your second attribute, and so on.
4. Click in the blank cell to the right of the first attribute you've named (in the **Value** column). Enter the value of this attribute for the first case.
5. To enter data for the next case (card), click the right arrow in the upper-right corner of the data cards.
6. Some attributes have units. For example, *Height* might be measured in units of inches or centimeters. You can type the names of these units into the **Unit** column. These units will be displayed along with their attribute name on plot axes.
7. **Save** your document as soon as possible.

Enter Data into a Case Table

If you have a lot of data to enter, you'll find it quicker to enter them into a [case table](#).

1. Choose **New** from the **File** menu to open a new TinkerPlots document.
2. Drag a case table from the object toolbar into the document to create an empty case table. In the case table, attribute names are listed along the top row. Values for case 1 are listed in the first row below the attribute names, values for case 2 are below those, and so on.

- Click the cell labeled **<new>** and type an attribute name. Press **Enter** to move to the cell below. (Note that when you press **Enter** TinkerPlots automatically opens a stack of data cards in the documents.)



- In the case table, enter the value of that attribute for case 1, press **Enter**, enter the value for case 2, and so on.
- Repeat steps 3 and 4 to create other attributes and enter their values.
- Save** your document as soon as possible.

Using the previous steps, you enter the data attribute by attribute. Sometimes it is easier to enter the data case by case, entering all the information for case 1 before going on to case 2, and so on. To enter data one case at a time in a case table,

- Enter all the attribute names along the top row.
- Click in the leftmost cell below the first attribute and enter the value for case 1.
- Use the **Tab** key to move along the row for case 1, entering all the data for that case.
- Press **Tab** after entering the last value for case 1. This will move you to the first attribute for case 2. Again, use the **Tab** key to move along the row and enter all the data for case 2. Repeat for the other cases.

Import Data

You can quickly import data into TinkerPlots from the Internet or from some other application, such as spreadsheet software or a word processor. There are three ways to do this: [copy and paste data](#), [import data from a text file](#), and [import data from the Internet](#).

Copy and Paste Data

- From within the application that contains the data (a word processor, spreadsheet, Web page, or whatever), highlight the entire collection and then copy it. Make sure the attribute names are in the first line you copy and that you copy nothing but the data.
- Click in a TinkerPlots document.
- Create a new stack of [data cards](#) and make sure it is selected. (An object is selected when you can see its frame. Clicking an object will select it.)
- Choose **Paste Cases** from the **Edit** menu.

Import Data from a Text File

- Create a new TinkerPlots document by choosing **New** from the **File** menu.
- Choose **Import From File** from the **File** menu.
- In the dialog box, select the file you want to import, then click **Open**.

Or,

- Drag the text file into a TinkerPlots document. The data will appear in a stack of [data cards](#).

Note: This method of importing data works only if the file is in text format. If it isn't in text format, you'll first need to open the file from within the program that made it (Microsoft Word

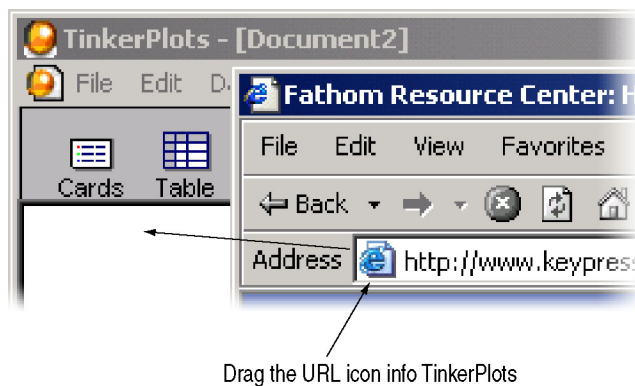
or Excel, for example), and then use the [Save As](#) command to save the file as a text file. TinkerPlots is fairly good at recognizing different text file layouts. But the easiest layout for TinkerPlots to deal with has the names of the attributes in the first line and the values below them, one line (paragraph) per case, as shown here. The values can be separated by tabs or by spaces.

Name	Gender	Weight
Faith	F	107
Tim	M	104
Priti	F	87

If your data imports, but uses the first case as the attribute names, open the text file in a word-processing program and add a line at the top with the attribute names. Then import this edited file.

Import Data from the Internet

1. Find the data you want on the Internet. Be sure you're looking at the page with the data (not a link to that page).
2. Drag the URL icon from your browser into an open TinkerPlots document. TinkerPlots will import the data into a new stack of [data cards](#).



Or,

1. Choose **Import From Url** from the TinkerPlots **File** menu.
2. Type or paste the URL of the data you want into the dialog box and click **OK**. The data will appear in a new stack of data cards.

Once the data are in TinkerPlots, check to make sure they imported correctly. The easiest way to do this is to look at them in a case table. You may need to do a little [repair work](#) by editing some of the data. If there are a lot of problems, it may be easier to export the data into a word processor or spreadsheet, fix the problems there, then import the data back into TinkerPlots.

- *Didn't get a color gradient for numerical data?* Sometimes when you import a collection, a numeric attribute will appear and behave like a category attribute. That is, its color bar will show distinct colors rather than a gradient, and when you graph the attribute, it won't make a number axis. What is probably going on is that one or more values of the attribute are characters rather than numbers. Even one case with some text in it will cause the entire attribute to be treated as a category attribute. To fix this, find and remove the text.

To save information about the data, such as where the data came from and definitions for the attributes, copy the information from the Web page and paste it into a TinkerPlots [text box](#).

Export Data

You can export data into spreadsheet software such as Microsoft Excel, statistical packages, or calculator-link software.

1. Select the stack of [data cards](#) containing the data you want to export.
2. Choose **Export Collection** from the **Data** menu.
3. Give the file a name, specify where you want it to be saved, then click **OK**. TinkerPlots will create a tab-delimited text file with the names of the attributes in the first line. Plots, text boxes, and other TinkerPlots objects will not be exported, just the data.
4. Switch to the application you want to view the data in, then use that program's import command to open the text file.

Working with Attributes

An *attribute* is a feature or characteristic of a case. If you collected data on how much weight students carry in their backpacks, backpack weight would be one of the attributes you'd be interested in. You might also collect from students their grade, gender, age, and body weight. Each of these is also an attribute.

In [data cards](#), attribute names are listed in the left column. In [case tables](#), attributes are listed along the top row. In [plots](#), cases are arranged along the vertical or horizontal axis according to their attribute values.

Add an Attribute

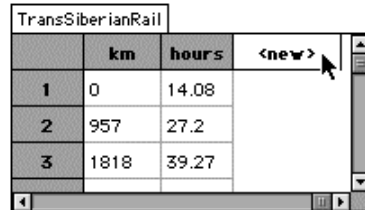
To add one or more attributes to an existing collection,

... in the Data Cards

1. Double-click the cell labeled **<new attribute>**. This is located on the bottom row of the data cards. If you can't see this cell, make the data cards larger by dragging the bottom edge.
2. Type the attribute's name, then press **Enter**. (See [Tips on Naming Attributes](#).)
3. To add additional attributes, repeat steps 1 and 2.

... in a Case Table

1. Click in the cell labeled **<new>** at the far right of the top row. (You may need to scroll the case table window to the right to see this cell.)



	km	hours	<new>
1	0	14.08	
2	957	27.2	
3	1818	39.27	

2. Type the attribute's name, then press **Enter**. (See [Tips on Naming Attributes](#).)
3. To add additional attributes, repeat steps 1 and 2.

Tips on Naming Attributes

Attribute names in TinkerPlots must begin with a letter or an underscore (_) and cannot include spaces or special characters such as percent signs (%), dollar signs (\$), and so on. Although you can't begin an attribute name with a digit, you can include digits anywhere else in the name (*Favorite1*, *Favorite2*, and so on). For multiple-word attributes, capitalize the first letter of each word (*PackWeight*) or use an underscore (*Pack_Weight*).

Keep attribute names as short as you can while making it clear what they are. Rather than including a unit as part of an attribute name (*Weight_lb*), enter the unit (lb) in the **Unit** column of the data cards.

Enter an Attribute Unit

Some attributes have units. *Height* might be measured in inches, for example, and *Weight* might be measured in pounds. You can enter the measurement unit in the **Unit** column of the data cards. Unlike attribute names, unit names can have spaces and symbols (“US \$,” for example).

To enter a unit,

1. In the data cards, click in the **Unit** column of the attribute.
2. Type the unit name.
3. Press **Enter**.

By default, the unit will appear along with the attribute name on graph axes. To control this display option, select a plot and choose **Hide Attribute Units** from the **Options** submenu of the **Plot** menu.

Rename an Attribute

1. Double-click the attribute name in the data cards, case table, or plot.
2. In the dialog box, type the new name, then press **Enter**. (See [Tips on Naming Attributes](#).)

Delete an Attribute

Deleting an attribute removes the attribute name and all its values from the collection. (If you accidentally delete an attribute, immediately choose **Undo** from the **Edit** menu to restore it.)

To delete an attribute,

1. In the data cards or case table, click the name of the attribute you want to delete.
2. Choose **Delete Attribute** from the **Edit** menu.
 - *Delete Attribute doesn't appear in the Edit menu?* You probably have one or more cases selected in the data cards. Click near the circle icon at the top of the data cards to deselect the case(s).

Hide/Show an Attribute

You may want to create additional screen space in a case table by hiding some attributes. When you hide an attribute, it's still there, you just can't see it. Note that you can hide attributes only in a case table. Data cards always display all of the attributes, even those that are hidden in a case table.

To hide an attribute in a case table,

1. Select the attribute you want to hide. (To select more than one attribute at a time, hold down the **Shift** key.)
2. Choose **Hide Attribute** from the **Data** menu.

To see an attribute that is currently hidden,

1. Select the case table.
2. Choose **Show Hidden Attributes** from the **Data** menu.

Change Attribute Position

... in the Data Cards

1. Select the attribute whose position you want to change.

2. Choose **Cut Attribute** from the **Edit** menu.
3. Select the attribute name above which you'd like the cut attribute to appear. (If you want the cut attribute to appear in the last position, don't select an attribute.)
4. Choose **Paste Attributes** from the **Edit** menu.

If your attribute has a formula, the formula will not be moved with the attribute. To move an attribute with a formula,

1. Select the attribute whose position you want to change.
2. Choose **Copy Attribute** from the **Edit** menu.
3. Select the attribute name above which you'd like the copied attribute to appear. (If you want the copied attribute to appear in the last position, don't select an attribute.)
4. Choose **Paste Attributes** from the **Edit** menu.
5. Select the original attribute you copied.
6. Choose **Copy Formula** from the **Edit** menu.
7. Select the copy of the attribute.
8. Choose **Paste Formula** from the **Edit** menu.
9. Select the original attribute you copied and choose **Delete Attribute** from the **Edit** menu.

... in a Case Table

1. Click the column head of the attribute whose position you want to change.
2. Drag the attribute name to the column location where you want it to appear.

Note: Changing the location of an attribute in the case table does not change the location of that attribute in the data cards.

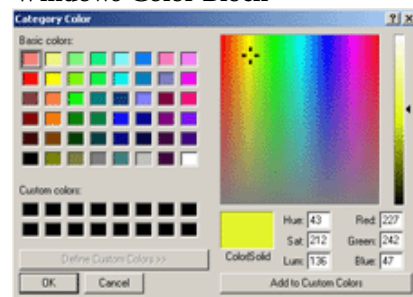
Change Attribute Color

TinkerPlots automatically chooses colors for attributes as you create them.

To choose your own attribute colors,

1. Double-click the color bar beside the attribute name in the data cards (you can also double-click the color bar in the color key of a plot). For numeric attributes, you can click anywhere along the color bar. For category attributes (like *Gender*), there's a different color for each category ("Male" and "Female"), so click the color in the bar (or color key) that you want to change.
2. In the color block (Win) or color wheel (Mac), click the new color you want and set the brightness level.

Windows Color Block



Macintosh Color Wheel



3. Click **OK**.

To revert to the default attribute colors,

1. Select the data cards.
2. Choose **Reset Attribute Color** from the **Data** menu.






Delete or Edit an Attribute Formula

When you delete the formula of a formula-defined attribute, TinkerPlots leaves the computed values in place but treats them as noncomputed (as though you had typed them in). The values in the data cards and case table turn from gray to black to indicate this change in status.

To delete or edit an attribute formula,

... in the Data Cards

1. Double-click the blue formula circle of the attribute. (If you can't see the **Formula** column, widen the data cards by dragging the right edge.)

	Attribute	Value	Unit	Formula
	number	1		
	even	false		

2. In the formula editor, the entire formula will appear highlighted. To delete the formula, press **Delete**. To edit the formula, click the part of the formula you want to edit and type your revisions.
3. Click **OK**.

... in a Case Table

1. Double-click the formula cell below the attribute. (If you can't see the formula row, make sure the case table is selected, then choose **Show Formulas** from the **Table** menu.)
2. In the formula editor, the entire formula will appear highlighted. To delete the formula, press **Delete**. To edit the formula, click on the part of the formula you want to edit and type your revisions.
3. Click **OK**.

Working with Values

Enter or Change Values

To enter or change a case's value for an attribute,

... in the Data Cards

1. Click in the **Value** column of the attribute, type the value, then press **Enter**.

... in a Case Table

1. Click in the appropriate cell, type the value, then press **Enter**.

You can also change a case's value in a plot by using the [Drag Value](#) tool.

Round Values

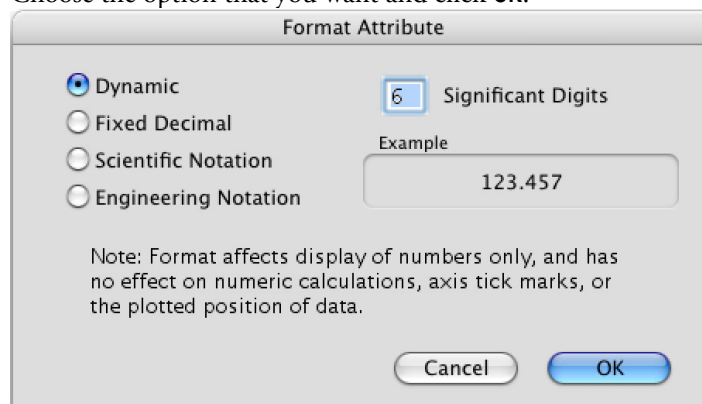
To round numeric values, set the number format as described in [Change Number Formats](#), or create a new attribute using the [round](#) formula. (Using a *round* formula actually changes the data. Using Change Number Format changes only how the data are displayed in data cards and case tables.)

Change Number Formats

You can control the way numbers appear in data cards and case tables without changing the number behind the appearance. For example, you can change the number of decimal places you see or switch to scientific notation.

To control the appearance of numbers in case tables and data cards,

1. Select the attribute whose number format you wish to change by clicking its name in a data card or case table.
2. Choose **Format** from the **Data** menu.
3. Choose the option that you want and click **OK**.



Changing the appearance of numbers in data cards or case tables will not affect where the values are plotted on a graph axis. It also will not affect the results of the formulas. Sometimes you want to round the actual numbers to the nearest integer value, and not just affect their appearance in the data cards. To round the actual data values, make a new attribute using the [round](#) formula.

Number Formats

Dynamic

The dynamic number format works well for most purposes. It doesn't display trailing zeros after the decimal point, and it keeps things out of scientific notation.

Fixed Decimal

This gives all numbers the same number of digits after the decimal point, as specified in the **Decimal Places** field.

Scientific Notation

A number expressed in scientific notation has one digit to the left of the decimal point, as many digits to the right as are specified in the **Significant Digits** field, and an exponent that tells you by what power of 10 to multiply.

Engineering Notation

In engineering notation, the number of digits to the left of the decimal point is one, two, or three, adjusted so that the power of 10 will always be a multiple of 3.

This chart gives some examples, all with six digits specified in the **Format Attribute** dialog box.

Entered	Dynamic	FixedDecimal	Scientific	Engineering
"1"	1	1.000000	1.00000e+00	1.00000e+00
"12345"	12345	12345.000000	1.23450e+04	12.3450e+03
".0123"	0.0123	0.012300	1.23000e-02	12.3000e-03
"12345678"	12345678	12345678.00...	1.23457e+07	12.3457e+06
"12.34567"	12.3457	12.345670	1.23457e+01	12.3457e+00

Working with Cases

Add Cases

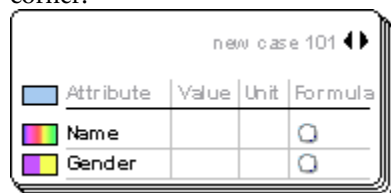
To quickly add any number of new cases to a collection,

1. Select a stack of data cards, a case table, or a plot.
2. Choose **New Cases** from the **Data** menu.
3. In the dialog box, enter the number of new cases to add and click **OK**.
4. Go to the newly created cases in the data cards or case table and enter data for the cases.

You can also add cases one at a time in data cards, case tables, or plots.

... in the Data Cards

1. Go to the last data card either by using the arrows at the top of the cards or by pressing **End** on your keyboard. The last card in the stack is labeled "new case" in the upper-right corner.



2. Click in one of the cells in the **Value** column and begin entering the data for the new case.
3. Press **Enter**. The new case will be added to the collection. Continue entering additional values for that case.

... in a Case Table

1. Scroll to the last row of the case table (or press **End**).

2. Click in one of the cells and enter the value for one of the attributes.
3. Press **Enter**. The new case will be added to the collection. Continue entering additional values for that case.

... in a Plot

1. Choose the **Add Case** tool from the lower plot toolbar.



2. Click in the plot to add a new case. If you have plotted attributes, the new case will be assigned values depending on where you click. (To quickly add multiple new cases in the plot, press **Alt** (Win) **Option** (Mac) either before or after choosing the **Add Case** tool.)
3. Add additional values for the new cases in the data cards or case table.

Delete Cases

1. Select the case(s) you'd like to delete in the data cards, plot, or case table.
2. Choose **Delete Cases** from the **Edit** menu.

Note: Deleting cases permanently removes them from the collection. If instead you want to temporarily remove one or more cases from a plot, use the [Hide Cases](#) command, use a [filter](#), or [restrict the range of a plot axis](#). You could also temporarily delete the case from the collection and then later choose **Undo** from the **Edit** menu to restore it.

Sort Cases

To change the order in which cases appear in the case table,

1. Click on the name of the attribute you want to sort by.
 2. From the Table menu, choose Sort Ascending or Sort Descending.
- *How do I sort by more than one attribute?* Suppose you want to sort by both grade level and by name so that all the 11th graders (sorted by name) come before all the 12th graders (sorted by name). First sort by name, then by grade. The sort by grade won't disturb the sort by name.

Get Case Information

Looking at a plot, you'll sometimes want to see all the information about a particular case. To do this,

1. In the plot, click the case that you want information about. The data card for that case will come to the top of the data cards stack. In the case table, that case's row will be highlighted.

Select/Highlight a Case

When you click a case, it is highlighted in all other objects in the document. If you have multiple plots of the same data, this allows you to easily see where a particular case is in each plot. Also, to delete a case, you must first highlight it. In data cards, you can only select one case at a time. To select multiple cases, use the case table.

To select a case,

... in the Data Cards

1. Bring the case to the top of the stack by using the arrow keys in the upper-right corner of the data cards.
2. Click the case circle in the upper-right corner of the card. A thick border will appear around this circle to indicate that the case is now selected. To deselect the case, click beside the case circle.

... in a Case Table

- Select a single case by clicking its row number. The row will now appear highlighted.
- Select more than one case by dragging along the cases' row numbers.
- Select contiguous cases by clicking the row number at one end of the desired location. Then hold down the **Shift** key and click the row number of the case at the other end of the series.
- To select cases that are not contiguous, hold down **Ctrl** (Win) **Command** (Mac).
- To deselect cases, click somewhere else in the case table.

... in a Plot

- To select a case in a plot, click the case icon. A thick border will appear around the icon.
- Select more than one case by dragging a selection rectangle around the case icons.
- Select non-contiguous cases in the plot by holding down the **Shift** key while using the selection rectangle.
- To deselect, click somewhere else in the plot.

Combine Collections

You can add one collection to another collection. These collections can be in the same document or in different documents. Combining collections can be useful when students from different classes have conducted the same survey and you want to put all the information into one collection.

To combine collections,

1. Make sure that the collections have the same attribute names and that the attributes are arranged in the same order in the data cards.
2. Select the stack of data cards that you want to add to the other stack.
3. Choose **Select All Cases** from the **Edit** menu. Then, from the same menu, choose **Copy Cases**.
4. Click on the stack of data cards that you want to add the cases to.
5. Choose **Paste Cases** from the **Edit** menu.
6. **Save**.

Check to make sure that the number of cases in the new, merged collection is the sum of the cases in the original two collections.

Make a Data Subset

You can work with subsets of your data. For details, see [Remove Some Cases from a Plot](#).

Rename a Collection

The name of a collection appears in the tab at the upper-left corners of plots, data cards, and case tables. By default, the first collection created in a document is named *Collection 1*.

To rename the collection,

1. Double-click the collection's name in the label.
2. Type the new name in the dialog box and click **OK**.

Or,

1. Select the stack of data cards, plot, or case table of the collection you want to rename.
2. Choose **Rename Collection** from the **Data** menu.
3. Type a new name in the dialog box, then click **OK**.

Prevent Collection Changes

Locking a collection will prevent you or someone else from mistakenly changing any of the data.

To lock a collection,

1. Select the collection you want to lock by clicking on the data cards, a plot, or a case table.
2. Choose **Lock Collection** from the **Data** menu.

To unlock a collection,

1. Select the collection you want to unlock by clicking on the data cards, a plot, or a case table.
2. Choose **Unlock Collection** from the **Data** menu.

Revert to Last Saved Collection

Sometimes you may have made several changes to your collection that you want to undo. These changes may include additions of new cases or new attributes, cases or attributes you have deleted, attribute colors you have changed, units you have added, or attribute formulas you have edited. As long as you haven't saved the changes, you can undo them in one step.

To remove all changes to your data since the last save,

1. Choose **Revert Collection** from the **Data** menu.
2. In the dialog box, click **OK**.

If you want to remove changes you made very recently, you may want to use the [Undo](#) command instead.

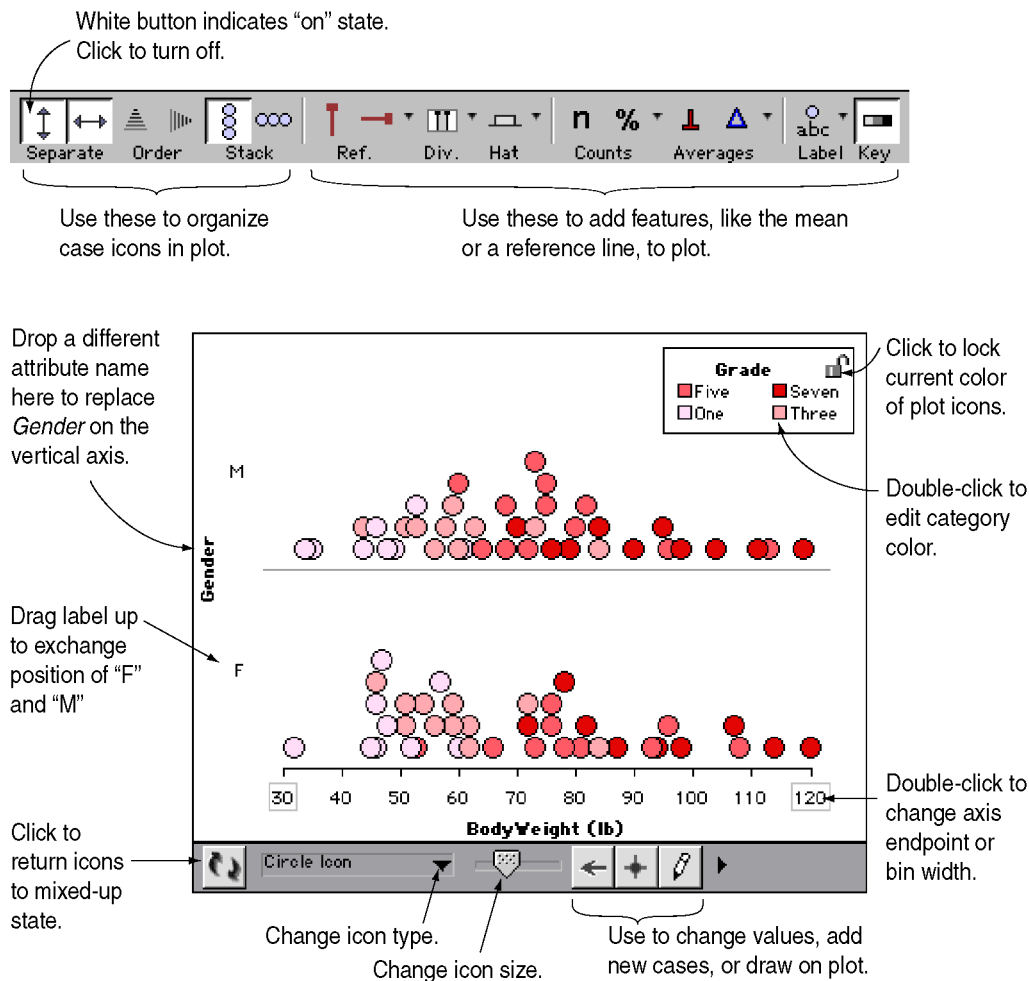
Recoding and Creating Data

Most data that come from the real world need some work before you can use them to find answers to your questions. Some of the more common situations and how to deal with them are described in [Common Uses of Formula-Defined Attributes](#).

Working with Plots

TinkerPlots has no menu of graph types. It has no scatter plots, histograms, or pie charts. In TinkerPlots, you construct graphs by progressively organizing the icons in the plot. You use commands such as order, separate, and stack and different icon types and options to build up what you want in stages. Nearly every operation works with all other operations, and by combining these you can make many different kinds of graphs. Because of this, the best way to learn TinkerPlots is to simply start experimenting with it.

Parts of a Plot



Make a New Plot

To make a new plot,

1. Drag a plot from the object toolbar (upper-left corner of window) into the document and drop it where you want it to appear.

In the plot you should see a random arrangement of circle icons. Each icon is a [case](#) in the [collection](#).

- Why is the plot empty?

If the plot is empty, it is probably because of one of two things.

- First, it could be that you have no data yet. Start [entering data](#) into the data cards.

- Second, the plot could be empty because you have more than one collection (stack of data cards) open in the document. The program doesn't know which data you want to plot.

To connect an empty plot to the correct set of data cards,

1. Locate the stack of data cards that you want to plot.
2. Drag the name of the collection, located in the tab at the upper-left corner of the data cards, into the empty plot. The whole plot window will highlight.
3. Release. The cases from the collection will appear in the plot as circle icons.

Basic Operations

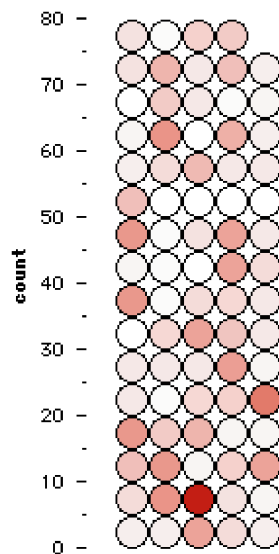
You can apply the different operations and features of TinkerPlots in any order to make a particular graph. Here we describe the three basic operations that you use to arrange case icons. These are [Stack](#), [Order](#), and [Separate](#). Using these in different combinations, you can make lots of [different graphs](#). The buttons for these three actions are located on the upper plot toolbar. When a button is on, it appears white and you can see its outline. In the example here, **Order** (vertical) is currently on. Clicking that button again would turn **Order** off.



Stack

Stacking arranges case icons in horizontal or vertical rows. To stack case icons vertically or horizontally,

1. Click the **Stack Vertical** or **Stack Horizontal** button in the upper plot toolbar. Click that button again to turn stacking off.



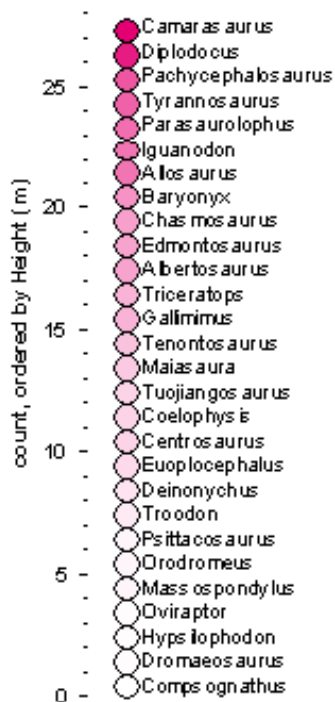
Here's some additional information about stacking.

- You can't stack both ways at the same time. So, if the icons are stacked horizontally and you click **Stack Vertical**, the **Stack Horizontal** button will turn off at the same time the **Stack Vertical** button turns on.
- If it can, TinkerPlots will stack the icons in a single column (or row). However, there often isn't enough room in the plot to do this. So TinkerPlots "wraps" the stack around, making

multiple columns or rows. If it needs even more room, TinkerPlots will squish the icons together. If you want to reduce the wrapping or squishing, [make the plot window larger](#) and/or the [case icons smaller](#).

- In some situations, stacking will do nothing to the plot (for example, when you have a scatter plot or a plot using [Fuse Circular](#) icons).
- By default, icons are stacked in random order. You can stack them in case order by choosing **Stack by Case Order** from the **Options** submenu in the **Plot** menu.

Tip: Make a stack and then order it by a numeric attribute. This makes a very simple graph that shows how cases “stack up” on a particular attribute. Below is a graph of dinosaurs, stacked and ordered by their height. If your question is “Who are the tallest and shortest?” this graph may be just what you need.

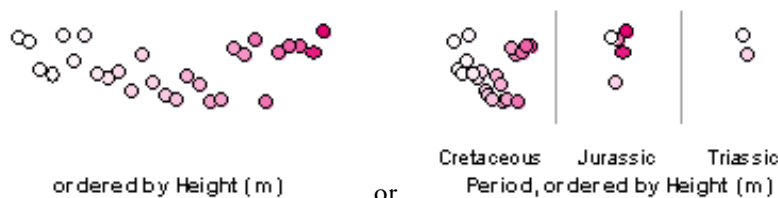


Order

Ordering arranges cases by their attribute values. To order case icons vertically or horizontally,

1. In the data cards, click the attribute you want to order by. This will select that attribute and use its color scheme to color the case icons in the plot.
2. In the upper plot toolbar, click the **Order Vertical** or **Order Horizontal** button. Click that button again to turn order off.

When you have order turned on, the name of the attribute you’ve ordered by appears in the plot window. For horizontal order, the name appears along the bottom of the window. For vertical order it appears along the left side. If there is also an attribute on an axis, the name of the ordered attribute appears after it, following a comma.



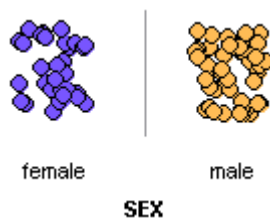
Here's some additional information about ordering.

- You can have both order buttons turned on at the same time, ordering in one direction by *Height*, for example, and in the other direction by *Weight*.
- For numeric attributes, cases are arranged in ascending order, from smallest (bottom or left) to largest (top or right). You can arrange in descending order by holding down **Alt** (Win) **Option** (Mac) as you order.
- For category attributes, cases are ordered alphabetically by the attribute's values. For example, you might use the words "One," "Two," "Three," and "Four" to code the *Grade* students are in. If you ordered the cases by *Grade*, TinkerPlots would order them "Four," "One," "Three," "Two."
- In some situations, ordering will do nothing to the plot (for example, it will not affect a scatter plot). The reason is that the case icons are "locked in place" in a scatter plot and there is no direction for them to move to show their order for another attribute.

Separate

This operation separates the cases in a plot according to their attribute values. For example, with a collection on students at your school, you might want to separate "male" from "female," or place students into separate groups according to their ages.

When you separate cases into groups, TinkerPlots adds bin lines between the groups, puts the name of the attribute you are separating by on the axis, and displays labels along the axis (such as "male" and "female") to show what's in each group.



There are three ways to separate icons into groups:

... by Dragging a Case Icon

1. In the data cards, click the attribute you want to separate by. This will select that attribute and apply its color to the case icons.
2. In the plot, drag a case icon either to the right or up to make two (or more) groups. (Drag to the left or down to make fewer groups.) Bin lines will appear between the groups.

Separate works a little differently with numeric and category attributes. With a category attribute, when you first drag you'll make only two groups. If you want to make more groups, go to the group labeled "other" and pull out another case/group. To make fewer groups, drag a case from a separated group towards the group label "other." With a numeric attribute, you can make from two to eight groups while dragging before the attribute [fully separates](#). To make more groups, drag any case icon to the right or up. To make fewer groups, drag to the left or down.

If there is already an attribute on the axis along which you're dragging, that attribute will not be replaced by a different, selected attribute. In this case, dragging will only change the number of groups of the attribute already on the axis.

... by Dragging an Attribute Name to an Axis

1. In the data cards, click an attribute name and drag it into either the left side or the bottom of the plot. The axis will highlight when you're over the right area.

If there is already an attribute on the axis, the new attribute will replace it. If there is no attribute on the axis, the attribute name you dragged will appear there. If the attribute is numeric, the cases will separate into two groups. If you want more groups, [drag an icon to the right or up](#). When you drag a category attribute to an empty axis, it will fully separate into as many groups as there are value types.

... by Clicking the **Separate** Button

1. In the data cards, click the attribute you want to separate by. This will select that attribute and apply its color to the case icons.
2. In the upper plot toolbar, click either the **Separate Vertical** or **Separate Horizontal** button.

The selected attribute name will appear along the axis and the cases will separate into two groups.

Mix Up

To return a plot to its original, disorganized state,

1. Click the **Mix-up** button on the lower plot toolbar.



The **Mix-up** button removes all features that have been added to a plot, including any attributes on the axes. The case icons will scatter randomly. If the icons are already mixed up, they will move to new random locations.

Remove an Attribute from an Axis

To remove an attribute from an axis,

1. In the upper plot toolbar, click the **Separate Vertical** button to remove an attribute from the vertical axis; click the **Separate Horizontal** button to remove an attribute from the horizontal axis.

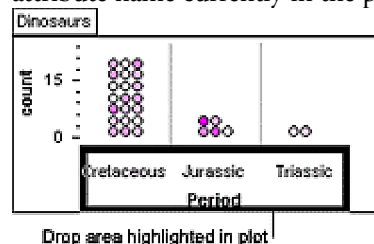
Or,

1. For a numeric attribute, drag any case all the way to the left (or down). For a category attribute, drag a case from one group towards another group. This will create a combined group called “other.” Continue dragging groups towards the “other” group until there are no bins remaining.

Replace an Attribute on an Axis

To replace an attribute on an axis with another attribute,

1. From the data card or case table, drag an attribute name and drop it on top of the attribute name currently in the plot.



Plot Two Attributes

To make a graph of two attributes,

1. In the data cards, click an attribute name and drag it into the bottom of the plot. The axis will highlight when you're over the right area.

2. Click another attribute name in the data cards and drag it to the left side of the plot.

Swap Axes

To swap axes so that the attributes on the horizontal and vertical axes change positions,

1. Choose **Swap Axes** from the **Plot** menu.

This also works when only one axis has an attribute. That attribute will move to the other axis.

Display Attribute Units

Some attributes have units visible in the [Unit column](#) of the data cards. By default, when an attribute name with units appears on an axis, the units are also displayed. If you don't want units to appear on the axes,

1. Choose **Show Attribute Units** from the **Plot** menu.

Choosing the option will remove the check mark and turn the option off. To turn it back on, choose it again.

Bins and Axes

Change Number of Numeric Bins

There are three ways to change the number of bins in graphs that have numeric axes:

. . . by Dragging a Case Icon in the Plot

1. In the plot, drag a case icon to the right (or up) to make more bins; drag left (or down) to make fewer bins.

By dragging icons, you can make from two to eight numeric bins. If you keep pulling after you have eight bins, the case icons will [fully separate](#).

. . . by Dragging a Bin Line

1. In the plot, place the cursor over one of the bin lines. The cursor will change into a double arrow.
2. To make more bins, drag the bin line left (or down); to make fewer bins, drag the bin line right (or up).

By dragging bin lines, you'll be able to make as many bins as you want before the attribute fully separates. As you drag the bin line, the axis labels change dynamically.

. . . by Changing the Axis Interval

1. Double-click one of the axis endpoints. (The endpoints are outlined in gray.)
2. In the dialog box, enter a new bin width and click **OK**. (Entering a smaller value will increase the number of bins. Entering "0" will [fully separate](#) the numeric axis.)

Change Number of Category Bins

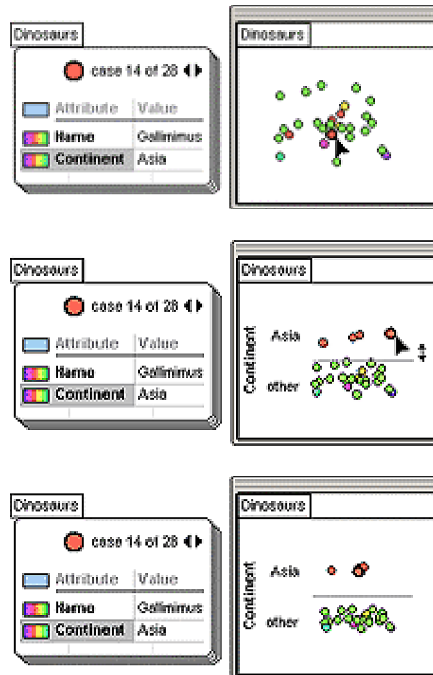
You can separate all values of a category attribute either in one step or one category value at a time.

. . . Separate One Bin at a Time

To increase the number of category bins one bin at a time,

1. In the plot, go to the bin labeled "other" and drag any case icon out of the bin. That case, and all the cases with the same value, will move into a new bin.

- Repeat step 1 until you have made as many bins (groups) as you want, or until the attribute is [fully separated](#).



To decrease the number of category bins one bin at a time,

- In the plot, go to a bin with only one type of value. For example, if the attribute is *Eye_Color*, you might go to a bin labeled “blue.”
- Drag a case from that bin toward the bin labeled “other.” All the cases in the “blue” bin will move into the “other” bin. (If the attribute is already fully separated, dragging toward any bin will combine two bins and make a new “other” bin.)

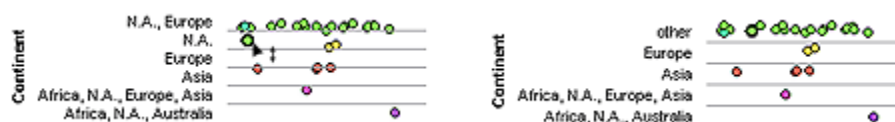
... Separate Fully into Bins in One Step

To fully separate a category attribute into as many bins as possible in one step,

- From the data cards, drag the name of the category attribute onto one of the plot axes (located on the left side and bottom of the plot).

All of the different values of the attribute will be visible on the axis.

You might now want to create an “other” bin by combining two particular categories. First move the two bins that you want to combine next to each other (see [Reorder Category Bins](#)). Then drag a case icon from one of the bins into the other bin. These two groups will mix in a new bin called “other.”



Adjust Axes

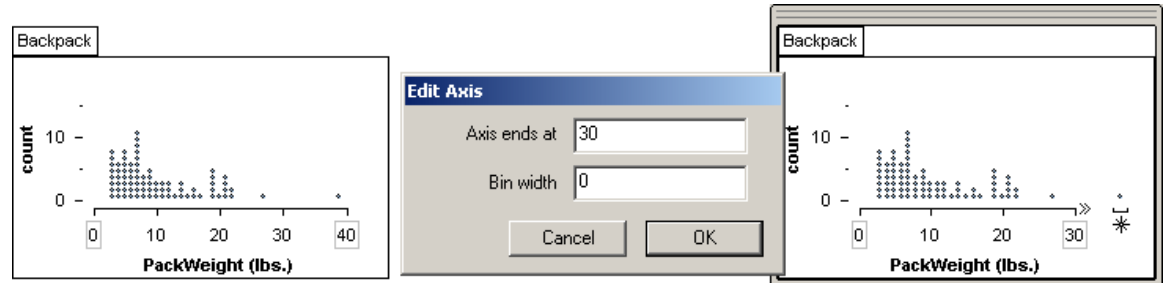
Change Axis Endpoints and Bin Widths

TinkerPlots automatically sets numeric axis endpoints and bin (or interval) widths. But sometimes you’ll want to set these yourself. For example, you might want to make the axes for two plots identical. Or you might want to zoom in on part of the graph where cases are bunched

together to see what's going on there. Or you might be [dragging an extreme value](#) to watch what happens to the [mean](#) and want to prevent the axis from automatically changing, which it would ordinarily do.

To adjust bin widths or axis endpoints of a numeric axis,

1. Double-click the axis endpoint you want to change or the width of the first or last bin. These endpoints and widths are lightly outlined in gray.
2. In the dialog box, enter the value you want for the endpoint or bin width.
3. Click **OK**.



In the example above, the endpoint was changed from 40 to 30. The case near 40 has moved off the axis and into the “excluded cases” stack, marked with an asterisk (*). Also, the upper end of the axis now has a >> symbol added. This tells you that there is at least one value beyond the current axis maximum of 30 that is not plotted over the axis.

At the same time you set a maximum or minimum for your axis, you can also set a bin width. Note that if you set both a new bin width and a new maximum, TinkerPlots might have to change the minimum value on the axis to give you what you want.

Return to Default Axes

If you have edited your axes but now want to return to the default settings,

1. Drag the attribute name from the data cards back onto the axis.

Reverse Axis Endpoints

By default, a numeric axis increases in value from left to right or from bottom to top. To reverse an axis so that the values decrease from left to right or from bottom to top,

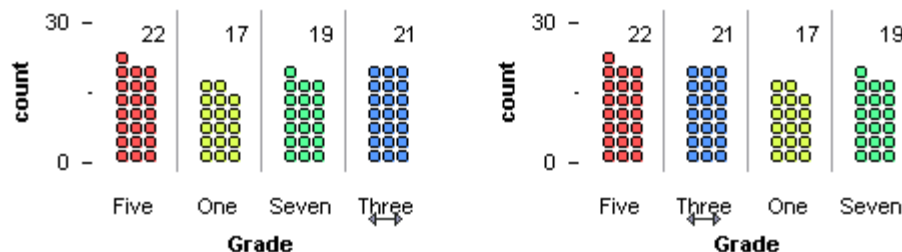
1. Drag one of the axis endpoints (outlined in gray) toward the other end of the axis.

Reorder Category Bins

You can freely reorder the bins of a category attribute. For example, you might want to arrange them according to how many cases are in each bin.

To move a category bin to a different place on the axis,

1. Drag a bin label to a new location along the axis.

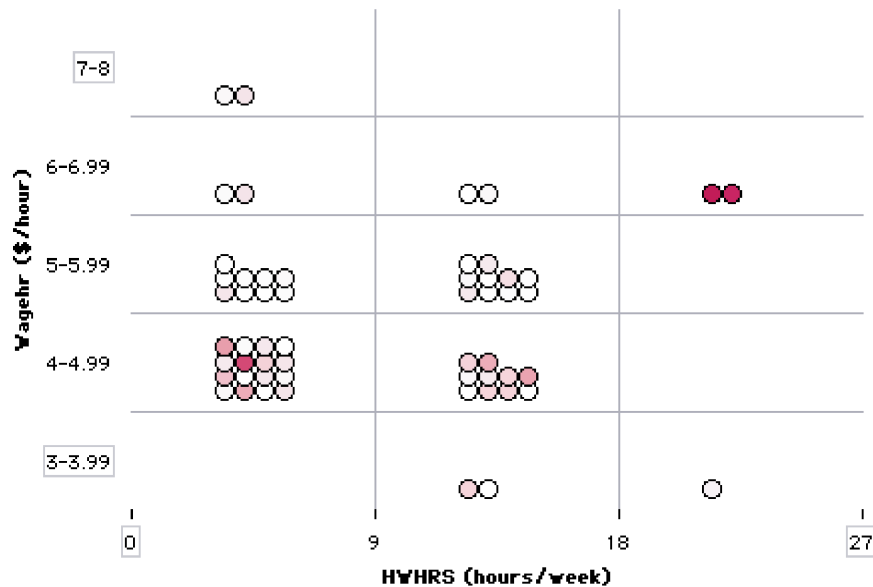


Use Continuous-style Bins

By default, bins of numeric attributes are labeled with their individual ranges, as shown on the vertical axis of the plot below. As an option, you can use a continuous style of labeling bins, as shown on the horizontal axis.

To use continuous-style bins,

1. Select the plot, and choose **Continuous-style Horizontal Bins** or **Continuous-style Vertical Bins** from the **Options** submenu in the **Plot** menu.
2. Choose the option again to revert to standard bins.



Case Icons

Icon Size

Case icons can be as small as 1 pixel and as large as 32 pixels across. There are three ways to change the size of case icons:

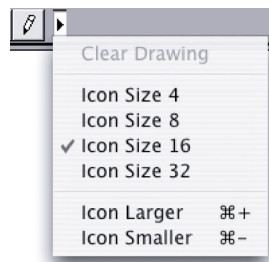
... Using the **Icon Size Slider**

1. In the lower plot toolbar, drag the **Icon Size** slider to the right to make icons larger or toward the left to make them smaller.



... Using the **Icon/Tool Options Menu**

1. In the lower plot toolbar, click the small triangle to the right of the **Drawing** tool. This opens the **Icon/Tool Options** menu.



From the menu, choose one of four icon-size options or choose **Icon Larger** or **Icon Smaller** to adjust icon size in one-pixel steps.

... Using **Shift**+ and **Shift**/–

1. Press the **Shift** key along with the + or – key to change the case icon size one pixel at a time.

Labels for Case Icons

You can add a label to each case icon. You can use this feature to show, for example, the name of each student in a collection or the gender of each case.

To label the icons in a plot with their attribute values,

1. In the data cards, select the name of the attribute you want to label by.
2. In the upper plot toolbar, click the **Label** button.

To change the attribute you use for labeling, turn off the **Label** button (by clicking it) and then repeat the steps above.

To change the position of the case icon label,

1. In the upper plot toolbar, click the small triangle to the right of the **Label** button. This opens the **Label Options** menu.



2. Choose the location you want.

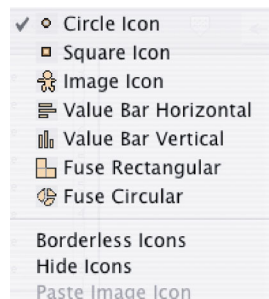
Labels do not resize as you [change the size of case icons](#). Because of this, labels usually are not very useful with large collections. However, you can make the case icons very small so that all you see is the labels. This is a way of making the labels themselves a type of case icon.

Case Icon Types

You can choose one of several icon types from the **Icon Type** menu on the lower plot toolbar. The name of the icon type currently being used in a plot is visible in the lower plot toolbar. The default setting is Circle Icon.

To change to one of the other icon types,

1. Click the small black triangle to the right of the icon type in the lower plot toolbar.
2. From the menu, choose the icon type you want.



Here's a brief description of the different icon types.

Circle Icon: By default, each case appears as a circle.

Square Icon: Each case appears as a square. You can stack squares to make graphs that look more like conventional bar graphs.

Image Icon: Each case appears as an image (for example, a cat or a person). You can [change image icons](#) or even [make your own](#).

Value Bar Horizontal: Each case of a numeric attribute appears as a horizontal bar. The length of the bar shows the case's value.

Value Bar Vertical: Each case of a numeric attribute appears as a vertical bar. The height of the bar shows the case's value.

Fuse Rectangular: Case icons are joined together into rectangles (as in histograms). Individual cases are still potentially visible as individual squares or rectangles.

Fuse Circular: Case icons are joined together into circles (as in pie graphs). Individual cases are still potentially visible as individual pie wedges.

Borderless Case Icons

Case icons typically have a black border around them to make cases distinct from one another. Sometimes, especially with large collections, these black borders make a graph harder to read.

To remove the black borders from case icons,

1. Choose **Borderless Icons** from the **Icon Type** menu on the lower plot toolbar.

That option will now appear in the **Icon Type** menu along with a check mark. To put borders back on icons,

1. Choose **Borderless Icons** again to uncheck it.

Invisible Case Icons

By [resizing case icons](#) you can make them as small as one pixel in diameter. But sometimes you'll want them to disappear completely, such as when you make a [box plot](#) or [frequency table](#). To make the case icons invisible,

1. Choose **Hide Icons** from the **Icon Type** menu on the lower plot toolbar.

That option will now appear in the **Icon Type** menu along with a check mark. To make the case icons visible again,

1. Choose **Hide Icons** again to uncheck it.

Reposition Case Icons

You can manually reposition icons in a plot. You might want to do this to spread out icons that are too close to, or overlapping, one another. You also might want to put case icons into groupings yourself, rather than have TinkerPlots do it for you.

You can freely reposition icons in a mixed-up plot. But you can also reposition icons in a plot that has bins (a plot where there is an attribute on at least one of the axes). You can also choose to have dragging always reposition cases, rather than separate them.

... in a Mixed-up Plot

To move case icons freely within a plot,

1. In the data cards, click the light blue bar to the left of the **Attribute** column heading. This deselects all attributes and makes the case icons the same blue color.
2. Click on a case icon and drag it to where you want it. Or [select several cases at once](#) and drag them together to a new location.

You can also apply an attribute's color scheme to the mixed-up case icons and still reposition them. To do this, hold down the **Alt** (Win) **Option** (Mac) key before you drag. By holding down

this key, you prevent the icons from separating into bins when you drag them. (Note that with this key down, the cursor looks like a hand when it's over a case.)

... in a Binned Plot

To reposition case icons within a bin,

1. Hold down the **Alt** (Win) **Option** (Mac) key.
2. Drag the case you want to move to a new position within the bin. (If you move a case outside the bin, it will come back into the bin when you release.)

If the cases are stacked within the bin, you will not be able to move a case icon anywhere you want and have it stay there. The icons will stay stacked as long as **Stack** remains on.

If the cases in a bin are not stacked, you can remix all of them within the bin. To do this,

1. Choose **Remix** from the **Plot** menu.

... in Any Plot

To make sure that dragging always repositions icons (rather than separates them),

1. Choose **Drag Case Always Repositions** from the **Options** submenu of the **Plot** menu.

Change Image Icons

Each collection that comes with TinkerPlots has an [image icon](#) available. The collection **Cats.tp** has images of cats; the collection **Backpacks.tp** has images of people. The document **Case Icon Library.tp** contains a collection of image icons you can use. The default image icon is the ball from the TinkerPlots logo.

To change the image icon of a collection,

1. Open the document **Case Icon Library.tp**. This file should be in the **TinkerPlots | Data and Demos** folder on your computer.
2. Click the icon you want to use to select it.
3. Choose **Copy as Picture** from the **Edit** menu.
4. Return to your TinkerPlots document and select the plot you want to paste this icon into.
5. In the lower plot toolbar, open the **Icon Type** menu and choose **Paste Image Icon**. The new image icon will appear in the plot.
6. **Save**. The image icon is saved with the collection. All plots using that data can use this image icon.

There are some disadvantages of using image icons in graphs rather than, say, circles. Image icons can make a graph look busy and make it harder to see general trends in the data. They also often make it harder to see the colors of the icons. And they take more computer memory and can slow down TinkerPlots animations. If TinkerPlots seems slow with image icons on, use circle icons to speed things up.

Make Your Own Image Icons

You can draw or modify an image to use as an image icon, using any painting or image editing program such as Microsoft Paint or Adobe Photoshop.

No matter what size you make an image icon, it will be resized to 32 by 32 pixels when pasted into a TinkerPlots document. So, to avoid distorted case icons it is best to use or make images that are 32 pixels square.

There are three parts to an image icon: the “visible parts” that make up the image, the “fill parts” that get colored with the attribute’s color scheme, and the “transparent parts” such as the area around the image that will not be visible in TinkerPlots.

Here are some specifications to help you make each of these parts of an image icon.

Visible parts: Black is best, because colors may compete with the attribute's colors.

Transparent parts: Use pure white (100% value plus 0% saturation, or RGB "255," or Web color "FFFFFF," depending on the color picker you use).

Fill parts: Use 80% gray (80% value plus 0% saturation, or RGB "204," or Web color "CCCCC," depending on the color picker you use).

Copy Image Icons

You can copy pictures to use as image icons from any program that supports display and copying of images. This includes Internet Explorer, Microsoft Paint, Word, QuickTime, and Adobe Photoshop.

To copy an image from another application and paste it directly into TinkerPlots,

1. Select the image in the application, then choose **Copy** from the **Edit** menu.
2. Switch to TinkerPlots and choose **Paste Image Icon** from **Icon Type** menu in the lower plot toolbar.

To also paste the image into the Case Icon Library where it will be available for other collections,

1. Open the document **Case Icon Library.tp** and click in the document background (white area). No frames around images icons should be visible.
2. Choose **Paste Picture** from the **Edit** menu.

Reference Lines

You can add one or more reference lines to any kind of plot. You can use these to help you sight to an axis, mark a critical cutoff point, or call attention to a particular part of the graph or case. Here we describe how to add, move, split, and get rid of reference lines. For some purposes, you may find that [dividers](#) are more useful.

Add/Remove a Reference Line

To add a single reference line to a plot,

1. In the upper plot toolbar, click one of the **Ref.** line buttons.



Using the buttons, you can add one vertical reference line and one horizontal reference line.

To add more than one reference line in the same direction,

1. Click the small triangle to the right of the **Ref.** line buttons. This opens the **Reference Line Options** menu.
2. Choose **Add Vertical Line** or **Add Horizontal Line**.

To remove a reference line,

1. Click the **Ref.** line button to turn it off.

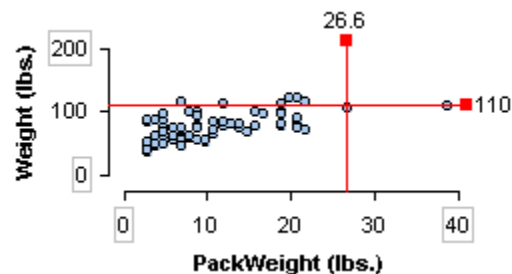
If you have several vertical reference lines, clicking the **Ref. Vertical** button will remove all of them. There isn't a way to remove them one at a time.

Reposition a Reference Line

1. Move a reference line by dragging its little square knob.

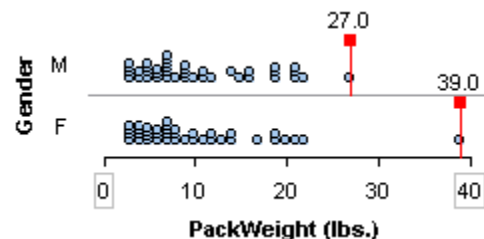
Read Axis Values with a Reference Line

If you have a continuous numeric axis, a reference line will display its position along that axis above (or to the right of) the square knob. With categorical axes or binned numeric axes, no values are displayed above (or to the right of) a reference line.



Split and Unsplit Reference Lines

When you have a reference line that goes across two or more bin lines, you can split the reference line so that you can move reference lines independently in each bin.



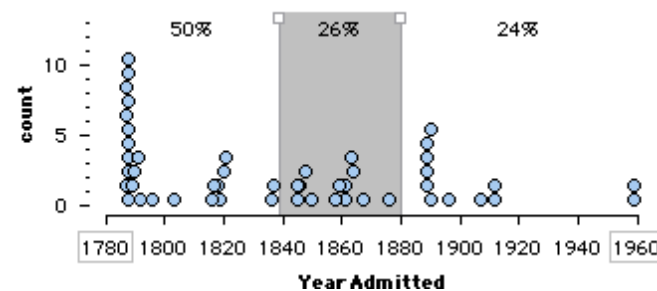
To split a reference line,

1. Click the small triangle to the right of the **Ref.** line buttons to open the **Reference Line Options** menu.
2. Choose **Split Reference Lines**.

A check mark will now appear in the menu next to the **Split Reference Lines** option. To re-join the reference lines, choose **Split Reference Lines** again. The check mark (and split in the line) will go away.

Dividers

You can use dividers on graphs with fully separated numeric attributes to divide the graph into sections. You can also use dividers along with counts or percents to see the number or proportion of cases in each section. The example shows the year in which each of the 50 U.S. states was admitted to the Union. Dividers are placed to show that by 1840 half of the 50 states had been admitted and that by 1880 another 26% had been added.



Add/Remove Dividers

To add two dividers to a graph with a fully separated numeric attribute,

1. Click the **Div.** button in the upper plot toolbar.



2. Click the **Div.** button again to remove the dividers.

Reposition a Divider

To reposition a divider,

1. Drag the divider by the white, square knob at the top of the divider.

Add Several Dividers

By default, you get two dividers when you click the **Div.** button. (Note that two dividers make three groups or divisions.) To add any number of dividers,

1. Click the small triangle to the right of the **Div.** button to open the **Dividers Options** menu.
2. Choose **Number of Divisions** or **Equal Width Dividers**.
3. In the dialog box, enter the number of divisions you'd like and click **OK**. Note that if you ask for five divisions, you'll get four dividers.

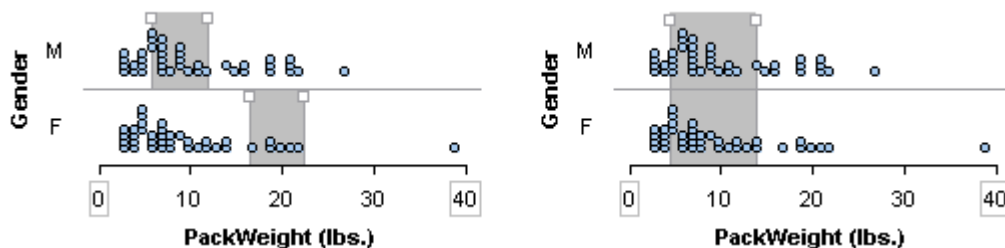
Equal Width and Equal Count Dividers

Equal width dividers divide a fully separated numeric axis into sections that have the same interval width along the axis. Equal count dividers create divisions that each contain roughly the same number of cases. To make either of these types of dividers,

1. Click the small triangle to the right of the **Div.** button. This opens the **Dividers Options** menu.
2. Choose **Equal Width Dividers** or **Equal Count Dividers**.
3. In the dialog box, enter the number of divisions you'd like and click **OK**. Note that if you ask for five divisions, you'll get four dividers.

Split and Unsplit Dividers

When you have dividers that go across two or more bin lines, the dividers are “split” by default so that you can adjust each set of dividers independently. To join (or “unsplit”) these dividers so that one set of dividers runs across all the bin lines,

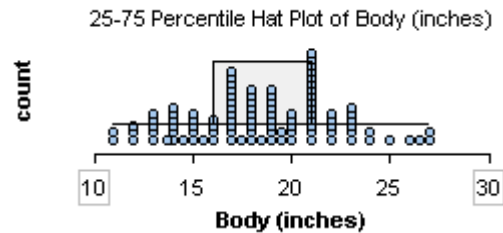


1. Click on the small triangle to the right of the **Div.** button. This opens the **Dividers Options** menu.
2. The option **Split Dividers** will have a check mark next to it. This indicates that the dividers are currently split. Choose this option, which will join the dividers. (If you look in the menu again, the option will now be unchecked.)

Hat Plots

Hat plots divide a numeric attribute into three sections that look somewhat like a hat. There is a central “crown” and, on either side of the crown, two “brims.” The brims extend out to the

minimum and maximum values. The example shows a percentile hat plot for the body lengths (in inches) of 100 cats and includes a [stacked dot plot](#) distribution of the same data.



To make a hat plot,

1. Add a numeric attribute to an axis and [fully separate it](#).
2. In the upper plot toolbar, click the **Hat** button.

In the **Hat Options** menu, you can select among four types of hat plots. Each type uses a different rule for constructing the central crown.

Hat plot type	Crown edges
Percentile (default)	25th and 75th percentiles
Range	1/3 and 2/3 of the range
Average Deviation*	-1 and +1 average deviations
Standard Deviation*	-1 and +1 standard deviations

* The *average deviation* and *standard deviation* are measures that tell you how far, on average, each score is from the mean. You can find the formula for the standard deviation in most statistics books. You hear less often of the average deviation, but it is easier to understand. Suppose you had the heights of 20 males and that the mean of the 20 heights was 65 inches. To compute the average deviation, you'd start by subtracting the mean of 65 from each of the 20 scores. So if the first male in the collection was 63 inches tall, you'd get a difference of -2 after subtracting the mean. You'd ignore the sign and just call the difference 2. The next height might be 65.5 inches, and you'd get a value of 0.5 inch after subtracting the mean. After computing this difference for each score, you'd add all the differences. Finally, you'd divide this sum of differences (say it was 30) by the number of cases, 20. This would give you an average deviation (in this example) of 1.5 inches, which would tell you that on average each score is 1.5 inches from the mean.

The default locations of the crown edges of each type of hat plot are somewhat arbitrary, but you can adjust them by dragging either crown edge once the plot appears. In this way, you could make percentile hat plots that included 90% of the cases in the center part, or standard deviation hat plots that included all the values between -2 and +2 standard deviations.

Counts and Percents

Counts show the number (or percent) of cases within each section of a graph. To see the number or percent of cases that are in various parts of a graph,

1. In the upper plot toolbar, click the **Counts (n)** button or the **Counts (%)** button.



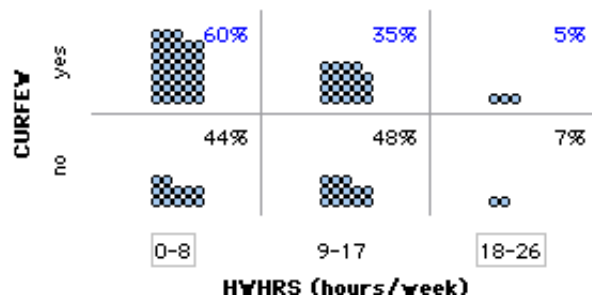
If there are no sections (bins or dividers), the **Counts (n)** button will show the total number of cases in the plot.

Percent Display Options

For binned graphs with attributes on both axes, there are three types of percents you can display in a cell (a cell is created by the intersection of two bin lines, as in the example).

Row Percents

By default, TinkerPlots displays row percents. Row percents are computed by dividing the number of cases in a cell by the total number of cases in that same row. In the example below, the 60% in the upper left cell is a row percent. It tells you that of the total 55 students with curfews, 60% ($33 \div 55 \times 100$) report spending from 0 to 8 hours on homework per week. The percents along the top are all blue to remind you that these are row percents (note that the percents in each row sum to 100%, with possible rounding error).



Column Percents

Column percents are computed by dividing the number of cases in a cell by the total number of cases in the same column.

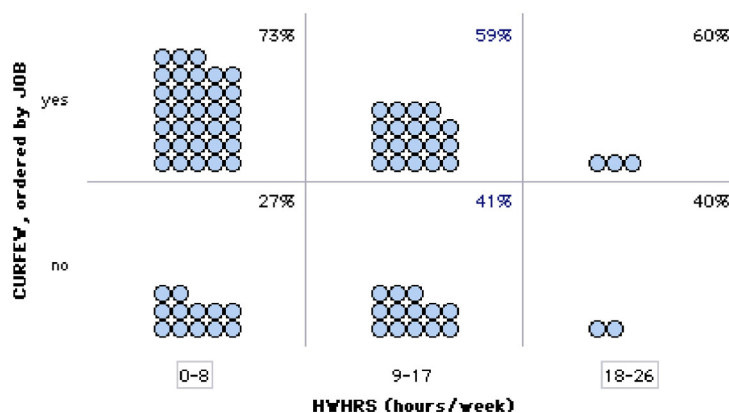
To display column percents,

1. In the upper plot toolbar, click on the small triangular button to the right of the **Counts (%)** button. This opens the **Percentage Options** menu.



2. Choose **Show Column Percents**.

If in the example you switch to column percents, the value in the upper-left cell changes from 60% to 73%. This column percent tells you that of the 45 students who reported spending from 0 to 8 hours per week on homework, 73% of them ($33 \div 45 \times 100$) had a curfew. The percents in the same column are all the same color (blue or black) to remind you that these are column percents.



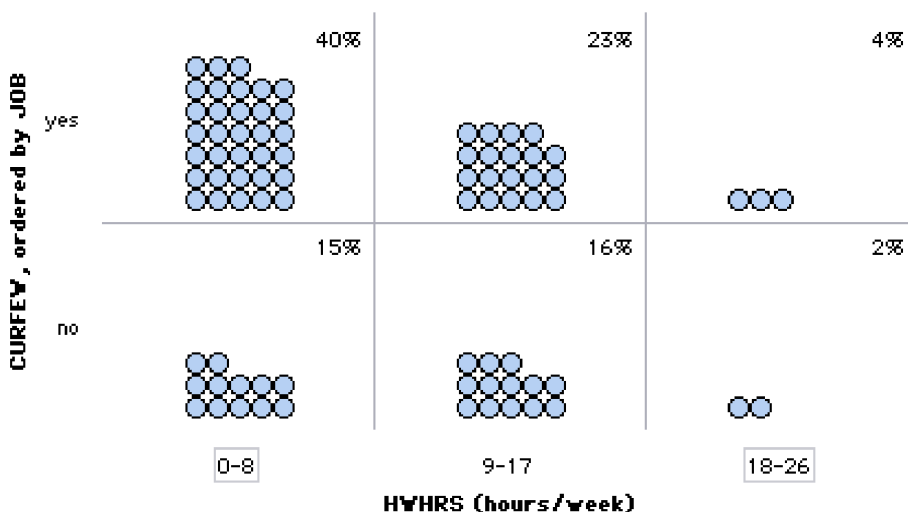
Cell Percents

Cell percents are computed by dividing the number of cases in a cell by the total number of cases displayed in the plot.

To display cell percents,

1. Click on the small triangular button to the right of the **Counts (%)** button in the upper plot toolbar. This opens the **Percentage Options** menu.
2. Choose **Show Cell Percents**.

If you switch the example graph to cell percents, the value in the upper left cell would change from 60% to 40%. This cell percent would tell you that of the total 82 students, 40% ($33 \div 82 \times 100$) both have a curfew *and* report spending from 0 to 8 hours per week on homework. The percents in all the cells would be black to remind you that these are cell percents.





Averages

You can add symbols to a graph to show the location of the [mean](#), [median](#), [mode](#), or [midrange](#) of a numeric attribute. (The *midrange* is the “middle of the range” computed by subtracting the minimum value from the maximum value and dividing by 2.)



On axes of [fully separated](#) numeric attributes, the symbols for these various averages will appear just below the axis. The symbol points to the location of that average on the axis. With a binned axis (not fully separated), a colored line will appear below the bin that contains the average. A blue line is used for the mean, red for median, gold for mode, and green for midrange. (*Note:* Lines are used with binned axes because the position of cases within a bin is arbitrary. A case farther to the right than another case in the same bin does not necessarily have a greater attribute value. Thus it would be misleading to try to show exact locations of averages within bins.)

Mean and Median

To add a symbol or line showing the location of the mean () or the median () of a numeric attribute,

1. In the upper plot toolbar, click the blue triangle (mean) or the red inverted T (median).

Mode and Midrange

To add a symbol or line showing the location of the mode () or the midrange () of a numeric attribute,

1. Click the small triangular button to the right of the **Averages** buttons in the upper plot toolbar. This opens the **Average Options** menu.
2. Choose **Show Mode** or **Show Midrange**.

Note that there may be multiple modes (most frequently occurring values) for an attribute. For binned axes, TinkerPlots considers a mode to be the *bin* that has the most values. Thus the values of modes can change as you change bin widths. Also, TinkerPlots doesn't show the location of modes for category attributes even though category attributes do have modes.

Display Values of Averages

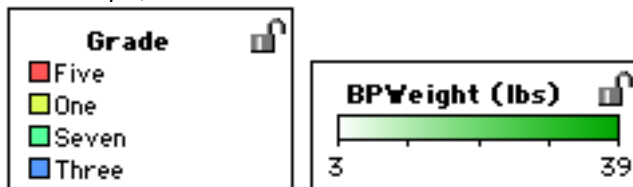
To display values of averages,

1. Click the small triangular button to the right of the **Counts (%)** button in the upper plot toolbar. This opens the **Average Options** menu.
2. Choose **Show Numeric Value(s)**.

You can find the values of averages without displaying those values in the plot. If you place the cursor over the average symbol in the plot, the value of the average will be displayed in the lower-left corner of the document window. For [fully separated](#) axes or [histograms](#), you can also use a [reference line](#) to get a close estimate of the value of an average. Place the reference line directly over the average symbol and then read off the axis position at the top of the reference line.

Color Key

When you select an attribute, the icons in the plot are colored with that attribute's color scheme. You can add a color key to a plot. It shows you what attribute is currently selected and what values are associated with the colors. Below are two examples of color keys, one of a category attribute (*Grade*) and the other of a numeric attribute (*BPWeight*). For a category attribute, the key shows the color for each value (each grade in this example.) For a numeric attribute, the color key shows the color of the gradient and the range of values of the attribute in the plot (3 to 39 in this example).



To add a color key to a plot,

1. In the upper plot toolbar, click the **Key** button.

Resize the key by dragging on a border. Move the key by clicking in a blank area within the key and dragging.

Lock Plot Color

You can lock a plot's color key to prevent the plot color from changing. This is useful when you have two or more plots of the same data. With multiple plots in a document, each time you select a new attribute, the plot color changes in all the plots. This is sometimes useful, but sometimes not.

To lock a plot's color,

1. In the upper plot toolbar, click the **Key** button.
2. Click the lock icon in the color key. The lock will close.
3. To unlock, click the lock again. It will open.

Note that if you lock a color key, you cannot remove the key from the plot until you unlock it. This is to help you remember that the plot color is locked.

Change Attribute Color Scheme

You can [change an attribute's color scheme](#) from the data cards or from the color key.

Get Case Information

Looking at a plot, you sometimes want to see all the information about a particular case. To do this,

1. In the plot, select the case that you want information about.

The data card for that case will come to the top of the stack of the data cards. If you have a case table open, that case's row will be highlighted.

Highlight Cases

You can select one or more cases in a plot to highlight them. Highlighted cases appear in the plot with a thicker, black border around them. When there is [no attribute selected](#), cases are highlighted in red. This makes them stand out even more.

- Select a single case by clicking its case icon.
- Select multiple cases that are clustered together in the plot by clicking in an empty part of the plot and dragging a rectangle around the icons you want to select.
- Select multiple cases that are not clustered together by holding down **Shift** and clicking each case.
- To make selected cases stand out, remove the plot color by clicking in the data cards on the light blue bar to the left of the **Attribute** column heading.
- To deselect cases, click somewhere else in the plot.

Brushing

When you highlight cases in a plot, those cases are highlighted in all other plots in the document. Highlighting cases in multiple plots is sometimes called *brushing*. It is a powerful way to detect interesting patterns or trends in the data. For example, in the data set **US Students.tp** you could make two graphs, one of students' heights and the other of their weights. Then you could highlight all of the tall students in the height graph and see where those students are on the weight graph.

Connecting Lines

When the data have been entered in a particular order, it is sometimes helpful to connect the cases in the plot with lines. The lines connect the cases according to their case order (from case 1 to case 2 and so on). This is especially useful with graphs of [time series](#).

To connect the cases with lines according to their case order,

1. Choose **Show Connecting Lines** from the **Plot** menu.

Caution: For most graphs, connecting cases with a line will make a mess. This option is useful *only* when the data have been entered in an order that is meaningful. For example, the collection in **NY Marathon.tp** is the winning times for the New York City Marathon, an event held every year. The cases in the collection have been entered in the order they were collected over the years. Therefore, when you connect the cases with a connecting line, the line goes from the first case, to the second case, and so on to the last case. So, when you make a graph with the year of the marathon on one axis, connecting the cases with a line makes a meaningful graph.

Remove Some Cases from a Plot

At times you want to see only a subset of the cases in a collection. For example, if you are exploring people's yearly incomes, you probably don't want to include children and retired people in your graph. You can remove cases from a plot in two ways: by selecting and [hiding](#) the cases, and by [making a filter](#) using a formula.

When you remove cases in these two ways, those cases not only disappear from the plot, they are also ignored in computing [percents](#), computing [averages](#), and drawing [box plots](#). Removing cases is therefore different from [changing a plot's axis](#) so that you can't see some of the cases.

Hide Cases

To hide one or more cases,

1. Select the case icons you want to hide. To select a single case, click on it. To select multiple cases, you can either click in an empty part of the plot and drag a rectangle around them or hold down the **Shift** key while you click each icon.
2. Choose **Hide Selected Cases** from the **Plot** menu.

You can repeat these steps as many times as you like, removing more and more cases from the plot. Also, you can choose **Hide Unselected Cases** from the **Plot** menu to hide the unselected cases.

To restore hidden cases to your plot,

1. Choose **Show Hidden Cases** from the **Plot** menu.

Filters

With a filter, you remove cases from a plot by using a formula that tells TinkerPlots which cases you want to keep in the plot.

To add a filter to a plot,

1. Choose **Add Filter** from the **Plot** menu.
2. In the formula editor, enter the expression you wish to use as a filter, then click **OK**.

In the formula editor, you'll generally want to type in an attribute name, a symbol such as = or <, and then an attribute value. For example, typing **Height > 70** would keep in the plot only cases with values of *Height* more than 70. Typing **Gender = "males"** would keep only the males. (Note that you need to put category-attribute values in quotes.) (See [Enter a Formula](#) for more help.)

When a plot is being filtered, the formula of the filter appears below the plot.

To edit a filter,

1. Double-click the formula located at the bottom of the plot.
2. In the formula editor, edit the formula, then click **OK**.

To remove a filter,

1. Choose **Remove Filter** from the **Plot** menu.

When a filter is removed, its formula is not erased. The next time you add the filter to the plot, the same formula will appear. You can toggle back and forth between the filtered and unfiltered state by pressing **Ctrl+F** (Win) **Command+F** (Mac).

Change Data Values

You can change the values of cases directly in a plot by dragging a case icon along an axis. As you drag, the case changes its value to the position you've dragged it to. This works for both numeric and category attributes.

To change the value of a case in a plot, you need at least one attribute on an axis.

1. In the lower plot toolbar, choose the **Drag Value** tool.



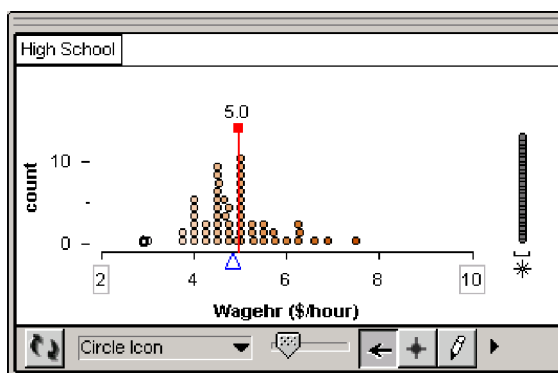
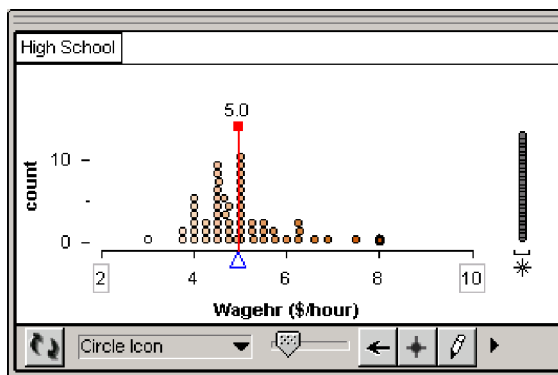
2. In the plot, move the cursor over the case icon you want to move. The cursor will change into a left-pointing arrow.
3. Drag the icon to a new location to change its value. (In the data cards, you can see the value changing.)

When you release the mouse, the **Drag Value** tool turns off. If you want to change the values of more than one case, repeat the steps above. Or hold down the **Alt** (Win) **Option** (Mac) key as you click on and drag cases. As long as you hold down this key, the **Drag Value** tool will stay on.

If you drag a case along a binned, numeric axis, the case is given the value of the lowest value of the bin. So a case dragged into a bin of heights that ranged from 60 to 63 would be given the value 60.

If the plot has attributes on both axes, you can drag a case both horizontally and vertically, changing its values for both attributes at the same time. If you want the case to change its value for only one of the graphed attributes, be careful to move it in only one dimension.

Tip: You can use the **Drag Value** tool to demonstrate the influence of an extremely high or low value on the mean. The graph shows how many dollars per hour high school students earned in their part-time jobs. The location of the mean (about \$5/hour) is shown as a blue triangle under the axis. Using the **Drag Value** tool, move the case at \$10/hour toward the center of the graph. As the case moves to the left, the mean triangle will also move to the left, but more slowly, of course. The [reference line](#) placed over the current mean helps show how much the mean changes. Also, the demonstration works better if you [fix the maximum value of the axis](#) at 10, to prevent the axis from automatically changing as the maximum value changes.



Add New Cases

You can add new cases directly in a plot. If you have a plot with attributes on the axes, the new case will be given values for the attributes based on where you place the new case.

To add a new case to a plot,

1. In the lower plot toolbar, choose the **Add Case** tool.



2. Move the cursor into the plot. It will change into a crosshair.
3. Position the cursor where you want the new case to appear and click. A new case icon will appear. A new data card will also be created for that case and will move to the top of the stack.

When you click again, the **Add Case** tool turns off. If you want to add several cases, repeat the steps above. Or hold down the **Alt** (Win) **Option** (Mac) key as you add a case. As long as you hold down this key, the **Add Case** tool will stay on.

If you add a new case into a binned, numeric axis, the case will be given the value of the lowest value of the bin. So a case added to a bin of heights that ranged from 60 to 63 would be given the value 60.

When you add cases to a numeric axis, they often don't get the exact value you'd like. After adding the case, you can [edit the value](#) in the data card or you can use the [Drag Value](#) tool reposition it and change its value.

Draw on a Plot

You can draw on a plot to call attention to particular parts of the graph, to show a trend, to title the plot, or to personalize it.

To draw on a plot,

1. In the lower plot toolbar, choose the **Drawing** tool.



2. When you move the cursor into the plot, it will change into a pencil. Draw and release.

Note that when you release, the **Drawing** tool turns off. If you want to continue drawing, repeat the steps above. Or hold down the **Alt** (Win) **Option** (Mac) key as you choose the **Drawing** tool. As long as you continue holding down this key, the **Drawing** tool will stay on.

To erase drawings from a plot,

1. In the lower plot toolbar, click the small triangle to the right of the **Drawing** tool and choose **Clear Drawing** from the menu.

Note that the **Drawing** tool has only one pen size and color (black). Also, if you resize a plot, the drawing doesn't rescale with the rest of the plot. So make the graph the size you want it to be before drawing on it.

Tip: On discovering the **Drawing** tool, some students may spend a lot of time drawing on their plots. You may therefore wish to remove the **Drawing** tool from the lower plot toolbar using the [Toolbars](#) submenu in the **Plot** menu. Note that this removes the **Drawing** tool only from the active plot. If you open a new plot, the **Drawing** tool will be visible there.

Duplicate a Plot

You can make an exact copy of a plot. This is often useful when you've made a graph that you want to save, but want to continue working from it rather than starting over from scratch. It's also useful if you want to make two similar graphs, say, one for males and the other for females.

You could [filter](#) out the males, make a graph for the females, duplicate it, and then change the filter to remove females.

To duplicate a plot,

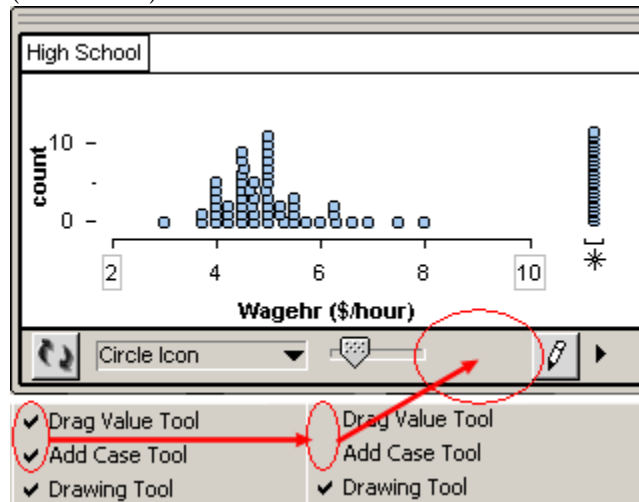
1. Select the plot you want to duplicate.
2. Choose **Duplicate Plot** from the **Edit** menu.

Change Plot Toolbars

You can remove buttons and other options from the plot toolbars. You might want to remove some features so that students just learning the program won't be distracted by them. Or you might want to remove the lower plot toolbar before printing so that it doesn't appear along with the graph.

To change the toolbars for a plot,

1. Select the plot you want to change.
2. Go to the **Toolbars** submenu of the **Plot** menu and choose the feature you want to remove (or add back).



Choosing **Hide Upper Plot Toolbar** or **Hide Lower Plot Toolbar** will remove all of the features on those toolbars at once. To restore the toolbars, choose **Restore Toolbars**. You can also remove features one at a time by scrolling to a checked feature and choosing it. A removed feature will appear unchecked in the menu. To restore that feature, select it again.

Note that you can remove features from only one plot at a time.

Slow Down Animation

Sometimes it's helpful for demonstration purposes to slow down the speed of an animation. To do this,

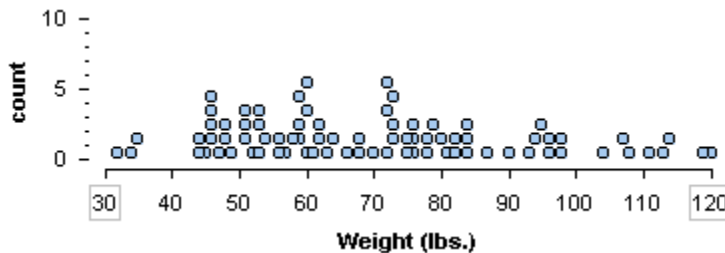
1. Hold down the space bar while clicking one of the buttons that causes case icons to move (**Stack**, **Order**, **Separate**, **Mix Up**, etc.).

Making Common Graphs and Tables

This section describes how to make various graphs and tables. Each example assumes that you are starting from a totally unorganized plot, such as the random display you get after clicking the **Mix-up** button. For graphs of only one attribute, the example describes how to make the graph along the horizontal axis, but you could make the same graph on the vertical axis. Also, for the most part it isn't necessary to follow the steps in the order listed.

Stacked Dot Plot

This graph shows how a numeric attribute is distributed while keeping each case clearly visible.

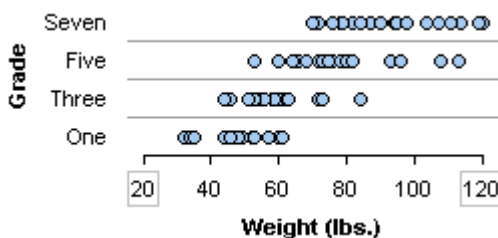


To make a stacked dot plot,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag any case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Stack vertically.* In the upper plot toolbar, click the **Stack Vertical** button.

Dot Plot

This graph displays all the cases of a numeric attribute in a single line that runs parallel to the axis. It is especially useful for comparing the distributions of several groups.



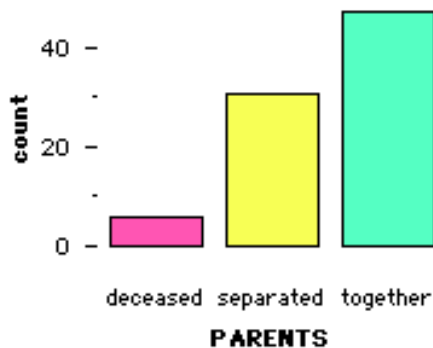
To make a dot plot,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag any case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Stack horizontally.* In the upper plot toolbar, click the **Stack Horizontal** button.

In this example, the category attribute *Grade* was added to the vertical axis (drag the attribute name into the left side of the plot) and the values of *Grade* were reordered (drag the value name to the desired location).

Frequency Bar Graph

This graph shows the counts for values of an attribute.



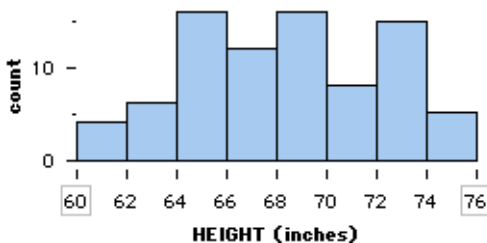
To make a frequency bar graph,

1. *Put an attribute on the horizontal axis.* From the data cards, drag the name of an attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Stack vertically.* In the upper plot toolbar, click the **Stack Vertical** button.

You can change the size or type of the icons using options on the lower plot toolbar. Here the icon type is set to **Fuse Rectangular** to make solid bars. With numeric attributes, you can also increase the number of bins by dragging an icon to the right.

Histogram

Histograms cluster cases of numeric attributes within intervals. They are especially useful when you have a large number of cases.



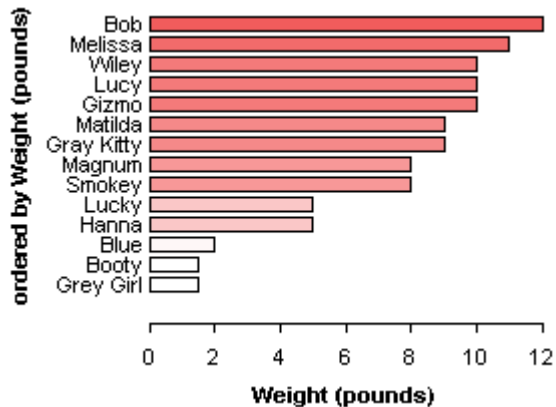
To make a histogram,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Separate the attribute into bins.* In the plot, drag any case icon to the right to create more bins (up to eight); drag left to reduce the number of bins.
3. *Stack vertically.* In the upper plot toolbar, click the **Stack Vertical** button.
4. *Fuse the icons.* In the lower plot toolbar, choose **Fuse Rectangular** from the **Icon Type** menu.

You can fine-tune the interval width either by [dragging the bin lines](#) or by [setting the interval width](#).

Value Bar Graph

Also known as a *case-value graph*, this graph displays the numeric value of each case as a bar of a particular length. The length of the bar depends on the value of the case. In the example here, the bar lengths correspond to the weight (in pounds) of each of 17 cats.



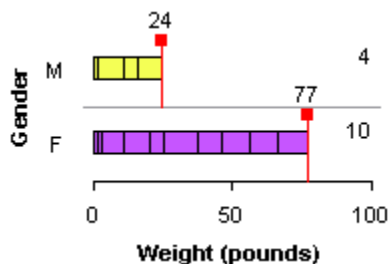
To make a value bar graph,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Set the icon type to Value Bar Horizontal.* In the lower plot toolbar, choose **Value Bar Horizontal** from the **Icon Type** menu.

In the example, the bars are also ordered vertically by *Weight* (with *Weight* selected in the data cards, click the **Order Vertical** button) and the bars are labeled with the cats' names (with *Name* selected in the data cards, click the **Label** button on the upper plot toolbar and then set them to display on the left).

Stacked Value Bar Graph

This graph displays the total of all the case values of a numeric attribute as a single bar. Each case appears as a separate section of the bar. The example shows 13 male cats weighing a total of 157 pounds while 13 female cats weigh 128 pounds in total.



To make a stacked value bar graph,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot window will highlight to indicate when you can drop).
2. *Set the icon type to Value Bar Horizontal.* In the lower plot toolbar, choose **Value Bar Horizontal** from the **Icon Type** menu.
3. *Stack horizontally.* In the upper plot toolbar, click the **Stack Horizontal** button.

In the example, another attribute, *Gender*, was added to the vertical axis (drag the attribute name to the vertical axis), the number of cases of each gender were displayed (click the **Counts (n)** button

in the upper plot toolbar), and two reference lines were added to help you read off the length of the two bars (click the **Ref. Vertical** button in the upper plot toolbar and access the menu to the right of the button to add a second line).

Pie Graph

Pie graphs display cases as pie wedges. Pie graphs are useful for comparing the relative numbers of values of various types. The example compares the proportion of male and female high school students who have curfews set by their parents. Be aware that the size of the circle gives no indication of the number of cases that are in it. A circle containing 100 cases will be the same size as a circle containing one case. This is why it's a good idea to display the number of cases in each pie. (See [Rectangle Graph](#) for a similar type of display that does indicate different sample size.)



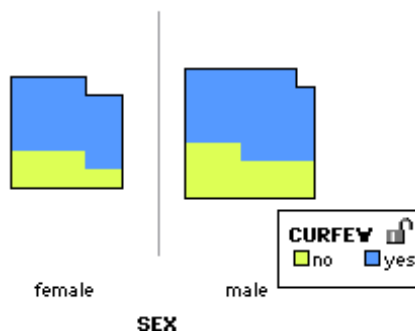
To make a pie graph,

1. *Set the icon type to Fuse Circular.* In the lower plot toolbar, choose **Fuse Circular** from the **Icon Type** menu.
2. *Put an attribute on the horizontal axis.* From the data cards, drag the name of an attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
3. *Color by another attribute.* In the data cards, click the attribute you want to use to color the pies.
4. *Order the cases.* In the upper plot toolbar, click an **Order** button to group cases of the same value in the pies.

In the example, a color key was added (click the **Key** button in the upper plot toolbar) and the number of cases for each gender was displayed (click the **Counts (n)** button in the upper plot toolbar).

Rectangle Graph

Similar to [pie graphs](#), rectangle graphs are useful for comparing the relative numbers of values of various types. The example compares the proportion of male and female high school students who have curfews set by their parents. One advantage rectangle graphs have over pie graphs is that the size of the rectangle gives information about the number of cases it contains: the larger the rectangle, the more cases that are in it.



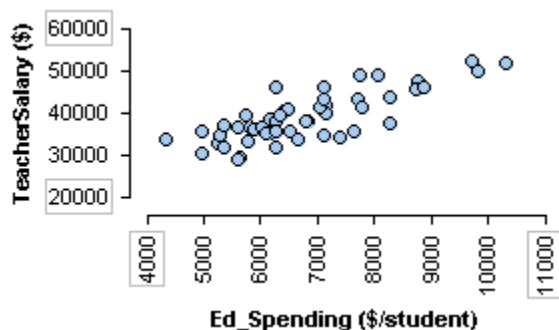
To make a rectangle graph,

1. *Set the icon type to Fuse Rectangular.* In the lower plot toolbar, choose **Fuse Rectangular** from the **Icon Type** menu.
2. *Put an attribute on the horizontal axis.* From the data cards, drag the name of an attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
3. *Color by another attribute.* In the data cards, click the attribute you want to use to color the squares.
4. *Order the cases.* In the upper plot toolbar, click an **Order** button to group like cases in the graph.

In the example, a color key was added (click the **Key** button in the upper plot toolbar).

Scatter Plot

A scatter plot allows you to explore the relationship between two numeric attributes with one displayed on the horizontal axis and the other on the vertical axis.



To make a scatter plot,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag any case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Put a numeric attribute on the vertical axis.* From the data cards, drag the name of a numeric attribute onto the vertical axis of the plot.
4. *Fully separate the attribute.* In the plot, drag any case icon all the way up to fully separate it vertically.

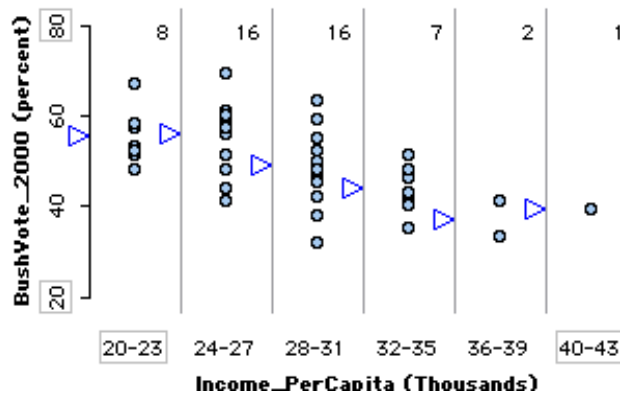
There is no option in TinkerPlots for displaying a line of fit on a scatter plot. However, you can use the [Drawing](#) tool on the lower plot toolbar to draw a line (or curve) yourself. You can also change the scatter plot into a [binned scatter plot](#) and use averages to help see a trend.

Often with scatter plots, two or more cases will lay exactly on top of one another because they have the same values for both attributes. There is currently no option for “jittering” cases so that you can see them or for creating special plotting symbols that stand for different numbers of cases. There are a few things you can do, however.

To locate overlapping cases, you can pull an icon up and move it temporarily out of the way to see if there are any hidden cases. You can also [create bins for one of the attributes](#). Finally, you can change the icon type to [Fuse Rectangular](#), which will put cases that are close together or the same value into rectangles in which you can see each individual case.

Binned Scatter Plot

This graph shows a numeric attribute binned along the horizontal axis and another numeric attribute, fully separated, on the vertical axis. The example shows the per capita income (in thousands of dollars) of the 50 U.S. states and the percentage of each state who voted for George W. Bush in the 2000 presidential election. This graph seems easier for people to interpret than a [scatter plot](#). And by adding the means of the bins (blue triangles), it provides a powerful way to see general trends in the data.



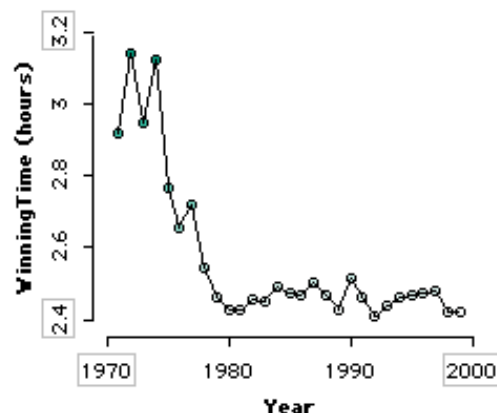
To make a binned scatter plot,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Separate the attribute.* In the plot, drag a case icon to the right to make two to eight bins.
3. *Put a numeric attribute on the vertical axis.* From the data cards, drag the name of a numeric attribute onto the vertical axis of the plot.
4. *Fully separate the attribute.* In the plot, drag a case icon all the way up. This will fully separate that attribute vertically.

In the example, the icons were stacked vertically (click the **Stack Vertical** button in the upper plot toolbar), the mean was added (click the blue triangle **Average** button in the upper plot toolbar), and a count was added to show the number of cases in each bin (click the **Counts (n)** button in the upper plot toolbar).

Time Series Graph

Also known as a *line graph*, a time series graph shows how the value of an attribute changes over time. The example shows the running time (in hours) for the female winner of the NYC Marathon over roughly the last 30 years.



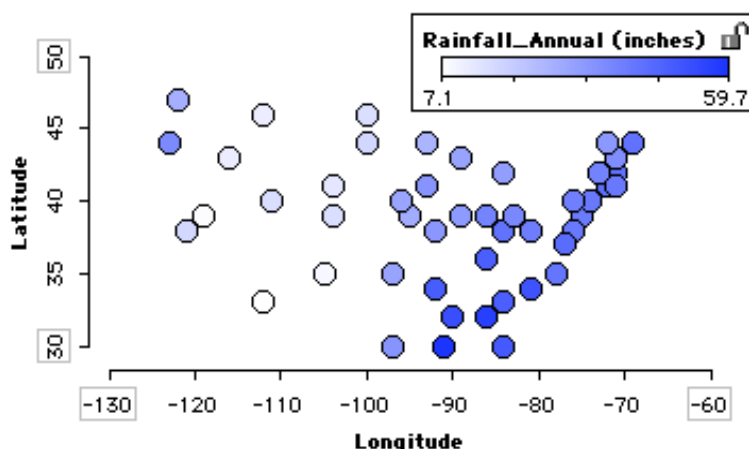
To make a time series graph,

1. *Put the time attribute on the horizontal axis.* From the data cards, drag the name of the time attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag a case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Put a numeric attribute on the vertical axis.* From the data cards, drag the name of a numeric attribute onto the vertical axis of the plot.
4. *Fully separate the attribute.* In the plot, drag any case icon all the way up to fully separate it vertically.

In the example, a line connecting the cases was added (choose **Show Connecting Lines** from the **Plot** menu).

Dot Map

Some collections include attributes that measure the location of cases in some physical space. With this type of data, you can make a map-like graph. The example shows the locations of the capitals of 48 of the 50 U.S. states using their longitudes and latitudes. The case icons are colored to show annual rainfall in each state.



To make a dot map,

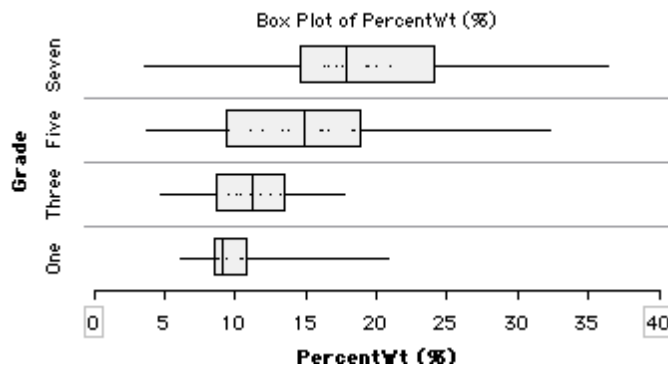
1. *Put the attribute measuring the horizontal position on the horizontal axis.* From the data cards, drag the attribute name onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag a case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Put the attribute measuring the vertical position on the vertical axis.* From the data cards, drag the attribute name onto the vertical axis of the plot.
4. *Fully separate the attribute.* In the plot, drag a case icon all the way up to fully separate that attribute vertically.
5. *Color the plot by an attribute.* In the data cards, click an attribute name to highlight it. This will apply that attribute's color scheme to the case icons.

In the example, a color key was added (click the **Key** button in the upper plot toolbar).

Box Plot

The “box” part of a box plot shows the locations of the 25th, 50th, and 75th percentiles. The box plot’s “whiskers” extend out to the end of the range. Box plots are particularly useful for comparing attribute values for several different groups.

The example shows how much students’ backpacks weigh as a percentage of their body weight. These results are shown separately for students in grades one, three, five, and seven. The box plots show that the older students tend to carry backpacks that are a higher percentage of their body weight. They also show that there is more variability (spread) in how much students carry at the higher grades than at the lower grades.



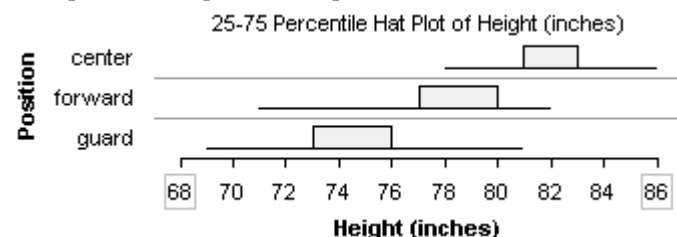
To make a box plot,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag any case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Add a box plot display.* In the upper plot toolbar, click the small triangle to the right of the **Hats** button and choose **Box Plot** from the menu.

In the example, the icons were stacked horizontally (click the **Stack Horizontal** button in the upper plot toolbar), case icons were made very small (adjust the slider in the lower plot toolbar), and another attribute (*Grade*) was added to the vertical axis (drag the attribute name from the data cards to the left side of the plot). As an option, you can set the box plots to show outliers (choose **Show Outliers** from the **Hat Options** menu).

Hat Plot

Hat plots divide a numeric attribute into three sections, a central “crown” and, on each side of the crown, two “brims.” The brims extend out to the minimum and maximum values. In the **Hat Options** menu, you can select among [four options](#) for how the crown of a hat plot is formed: based on percentiles (the default), the range, the average deviation, and the standard deviation. The example uses the percentile option.



To make a hat plot,

1. *Put a numeric attribute on the horizontal axis.* From the data cards, drag the name of a numeric attribute onto the horizontal axis of the plot (the lower part of the plot will highlight to indicate when you can drop).
2. *Fully separate the attribute.* In the plot, drag any case icon all the way to the right (until there are no bin lines). This will fully separate that attribute horizontally.
3. *Add a hat plot display.* In the upper plot toolbar, click the **Hat** button.

In the example, the case icons were hid (choose **Hide Icons** from the **Icon Type** menu in the lower plot toolbar) and an attribute (*Position*) was added to the vertical axis (drag the attribute name from the data cards to the left side of the plot). You can drag the edge of any hat crown left or right to set percentile-division points to different values.

Frequency Table

Frequency tables display the counts (and/or percents) of cases of various types. You can make frequency tables for a single attribute, or for two attributes as in our example. The example shows the numbers (and percents) of male and female high school students who have and don't have a curfew. The example show the values in two different colors to indicate how the percents were calculated. Here the percents were based on the row totals, so they show what percent of males (65%) and what percent of females (71%) have curfews.

SEX	male	17 (35%)	31 (65%)
	female	10 (29%)	24 (71%)
		no	yes
		CURFEW	

To make a frequency table,

1. *Put an attribute on the horizontal axis.* From the data cards, drag the name of an attribute onto the horizontal axis of the plot (the lower part of the plot window will highlight to indicate when you can drop).
2. *Add counts and/or percents.* In the upper plot toolbar, click the **Counts (n)** button and/or the **Counts (%)** button.
3. *Hide the case icons.* From the **Icon Type** menu in the lower plot toolbar, choose **Hide Icons**. (You could also adjust the **Icon Size** slider in the lower plot toolbar to make the icons very small.)

In the example, the category attribute *Sex* was added to the vertical axis (drag the attribute name onto the far left side of the plot).

Making a Report

TinkerPlots has the basic tools necessary to write and print a report, but TinkerPlots is not a word processor. If your report is long and complex, you will do better to copy your results from TinkerPlots and paste them into another application designed specifically for report writing. For an example of a report, see **Backpack Report.tp**, located in the **Data and Demos | Demos** folder.

Enter Text

1. Drag a text box from the object toolbar (upper left of window) into your document.



2. Type in the text box. Resize the box by dragging a corner or an edge.

Here are some things to know about text boxes.

- Formatting options and a tool palette are available in the **Text** menu.
- You can have as many text boxes as you like in your document.
- A text box that is empty and not selected appears with a gray border around it to indicate where it is.
- Generally it's not a good idea to place a text box on top of a plot (to use as a title, for example). When you select the plot, the text box will move behind it and be invisible. Place text boxes describing the graph next to the plot.

Paste Pictures

You can paste pictures from other applications into TinkerPlots. If you are writing a report, this might be a good way to illustrate parts of it.

1. In another application, copy a picture onto the clipboard.
2. Open a TinkerPlots document. Make sure that nothing is selected in your document. (Click in an empty space to deselect all objects.)
3. Choose **Paste Picture** from the **Edit** menu.

You can resize the picture just as you would any other object in TinkerPlots by dragging the edges of its frame.

You can also copy and paste pictures of TinkerPlots objects (for example, if you want several static graphs that no one can change).

1. Select the object.
2. Choose **Copy Picture** from the **Edit** menu.
3. Click in an empty area of the TinkerPlots document (to deselect all objects).
4. Choose **Paste Picture** from the **Edit** menu.

Copy Objects into Other Applications

You can copy objects from your TinkerPlots document and paste them into another application. They will be pasted into the other application as pictures, not as dynamic TinkerPlots objects.

1. Select the object you wish to copy.
2. Choose **Copy Picture** from the **Edit** menu.
3. Switch to the application into which you wish to paste the picture, then choose **Paste** from that application's **Edit** menu.

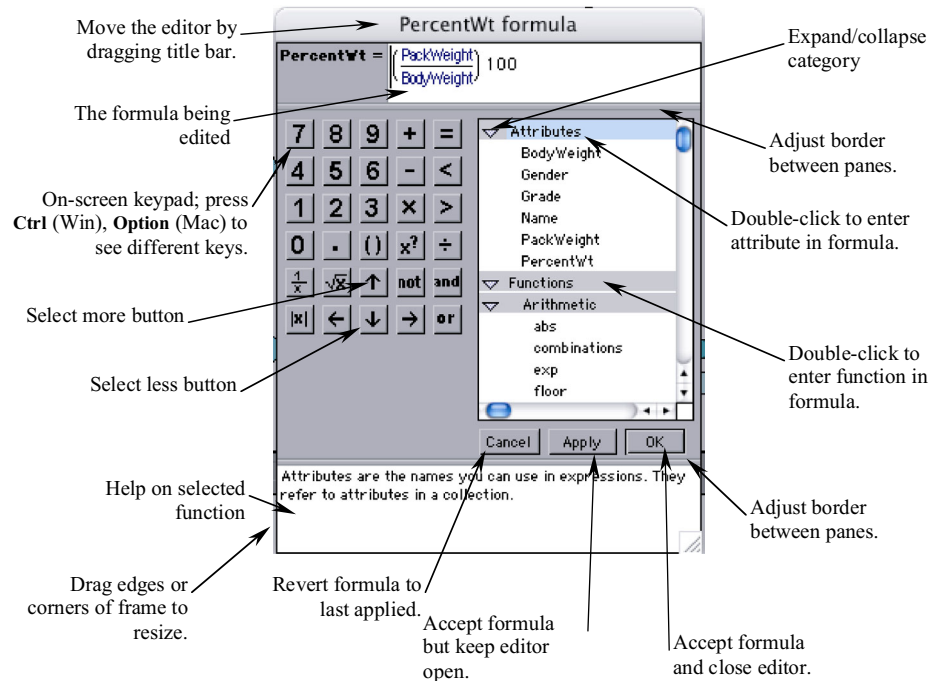
The picture you paste is not a live TinkerPlots object. If you change something in the original TinkerPlots document that you want reflected in the other document, you'll need to copy and paste it again.

Working with Formulas

You can use formulas to define attributes and to filter out cases from a plot. The following sections describe some common applications of each of these uses.

Parts of the Formula Editor

This is the formula editor as it appears on a Macintosh platform.



Use a Formula to Define an Attribute

You can use formulas to compute values for an attribute. For example, in a collection on countries you might have the attributes *Land_Area* and *Population*. You could define a new attribute, *Population_Density*, by writing a formula that divides *Population* by *Land_Area*.

Note: Creating a formula for an existing attribute deletes any values currently in that attribute. First create a new attribute unless you want to replace your data with the calculated values.

To define an attribute using a formula,

... in the Data Cards

1. Enter the name of the new attribute into the **<new attribute>** cell at the bottom of the data cards.
2. Double-click the circle in the **Formula** column. (If you can't see the **Formula** column, widen the data cards by dragging the right edge.)
3. Enter the formula into the formula editor and click **OK**. (See [Enter a Formula](#).)

When you've added a formula, the circle in the **Formula** column of your new attribute changes to blue, and the values of the attribute appear light gray rather than black. These changes remind you that the values of this attribute are computed with a formula.

... in a Case Table

1. Enter the name of the new attribute into the <new> cell, in the column head in the far right of the case table.
2. Choose **Show Formulas** from the **Table** menu. A shaded row of formula cells appears.

RandomRectangles		
	length	width
=		
1		
2		

3. Double-click the formula cell under the attribute you want to define by formula.
4. Enter the formula into the formula editor and click **OK**. (See [Enter a Formula](#).)

The computed values of the attribute appear light gray rather than black in the case table. This reminds you that the values of this attribute are computed with a formula. To see the entire formula in the formula row of the case table, you may need to make the cell taller or wider.

Use a Formula to Filter a Plot

You can use formulas to filter out cases from a plot. The filtered cases will still appear in the data cards. To filter out cases,

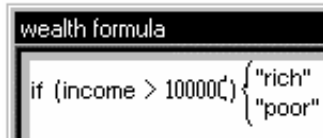
1. Select the plot and choose **Add Filter** from the **Plot** menu.
2. Enter a formula in the formula editor that specifies which cases you want to keep in the plot and click **OK**. (See [Enter a Formula](#).)

Enter a Formula

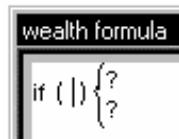
When you open the formula editor, the cursor is in the formula pane. To enter a formula, type in the formula pane, click buttons on the keypad, or use the attribute and function list. Most likely you'll use a combination of these methods. Here are a few suggestions that will come in handy.

- Click on an item to get an explanation of it in the help pane at the bottom of the formula editor.
- When things don't work the way you want, use parentheses.
- The up-arrow key is very useful when you want to understand the structure of an expression.
- The formula editor is *not* case sensitive. You can type all lowercase, and TinkerPlots will interpret your expression correctly. For example, **Round** works as well as **round**.
- When you have correctly typed an attribute name, it turns blue.
- When you have correctly typed a slider name, it turns magenta.
- Type * (**Shift+8**) for multiplication, / for division, and ^ (**Shift+6**) for exponentiation. When you've typed an exponent, use the right-arrow key to exit it.
- Enter π by typing **pi**. As soon as you type an operator or press any of the arrow keys, the symbol π appears in place of "pi."
- When you type the left parenthesis for a correctly spelled function, the function name turns red.
- When you type an open parenthesis, TinkerPlots gives you both open and close parentheses, with the cursor between them. You can simply begin typing. To exit the parentheses, type a close parenthesis or use the right-arrow key.
- Multiplication is sometimes indicated as a dot between terms and sometimes, as in traditional algebra, as nothing between terms (though you need to put the asterisk in).

- When you type an open quote, TinkerPlots gives you both open and close quotes, with the cursor between them. You can simply begin typing. To exit the quotes, type a close quote or use the right-arrow key. You must use quotes to enter string values in formulas (such as "rich" in the following example).



- When you type `if (` you get a complete (though empty) if-statement, with three parts for you to fill in (as shown below). Type the condition (in the example above, `income > 100000`), then use **Tab** to move to the results (result-if-true goes on the top, result-if-false on the bottom). If you want the results to be words (also known as *strings*), you must surround them with quotation marks. (See [Make If- and Switch Statements.](#))



- When you have more than two results, instead of nesting if-statements, you can use the *switch* function. This is useful for recoding attributes. The *switch* function takes an optional expression inside parentheses and then evaluates each of any number of true/false expressions to determine which value to return. To add an alternative, press **Insert** (Win) **Command+Option+Return** (Mac) on your keyboard. (See [Make If- and Switch Statements.](#))

Apply the Formula

You cannot do other things in TinkerPlots with the formula editor open.

- The **Apply** button causes the formula to be stored and evaluated, but does not close the formula editor. This can be very helpful when you are not sure how to get the formula you want or when you want to try different options.
- The **OK** button causes the formula to be stored and evaluated and closes the formula editor.
- The **Cancel** button closes the formula editor without changing the formula from what it was the last time you applied changes.

Adjust the Formula Editor Panes

When you want to see more of various portions of the formula editor, for example, when you have a tall formula or you want to see more of the formula list, you can adjust the size of the formula pane and help pane by dragging their borders. For example, you might have a very tall formula or you may want to see more options in the attribute and function list.



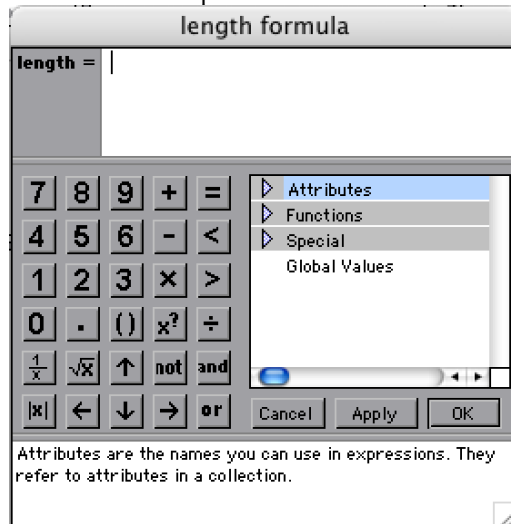
Use the Keypad

Click the number and symbol buttons in the keypad to enter them into a formula. Everything that can be entered from the keypad can also be entered by typing on your computer's keyboard. When you press **Ctrl** (Win) **Option** (Mac), you can see alternative buttons in the keypad, such as \geq .

Use the Attribute and Function List

Enter parts of your expression by double-clicking on items in the attribute and function list. This is handy if you have long attribute names or if you can't remember exactly how to spell a particular function.

- To see a list of choices in a given category, click the open/close control next to it. Here the user is about to open the attributes list.



- To enter an item from the list into the formula, double-click it.
- To close a list, click the open/close control.
- To see an explanation of an item, click it once to select it. You can then read about that item in the help pane at the bottom of the formula editor. This is especially handy if you can't remember the exact syntax for a function.

Move the Cursor and Select a Portion of an Expression

Moving and positioning the cursor in the formula editor can be tricky. Here are some tips for getting what you want to happen.

- Generally you can click the mouse where you want to position the cursor, but when that fails, try the right- and left-arrow keys either on the formula editor keypad or on your computer keyboard.
- If you are inside a parenthetical expression, typing a right parenthesis, `)`, will move the cursor to the right and outside of that expression.
- If you are inside a quoted expression (a string), typing a double quote will move the cursor to the right and outside the quoted expression.
- Pressing the **Tab** key will select the next portion of the expression. It's particularly helpful when you have if- or switch statements and you want to get to the next section.
- The up-arrow keys on the keypad and the computer keyboard will select the next largest portion of the expression starting from the current selection. (For example, pressing the up-arrow key several times will generally select the entire expression.)
- The down-arrow keys on the keypad and the computer keyboard will select the next smallest portion of the expression. (This is less useful than the up-arrow key, because it is hard to predict which smaller expression will be selected.)

Copy and Paste Formulas

- To copy an attribute formula without opening the formula, click the attribute name and choose **Copy Formula** from the **Edit** menu.
- To paste an already-copied formula into an attribute, click the attribute name and choose **Paste Formula** from the **Edit** menu.

Note: To remove a formula entirely, choose **Clear Formula** from the **Edit** menu.

Make Boolean Expressions

Boolean expressions are expressions that can either be true or false. They are useful in creating filters. For example, if you're looking at population data and you want to find women over 60 who are either married or divorced, then the expression below will filter out from the plot any people in the census file that do not fit this category.

```
(sex = "F") and (age > 60)  
and ( (marital = "Mar") or (marital = "Div") )
```

Here are some tips for making Boolean expressions.

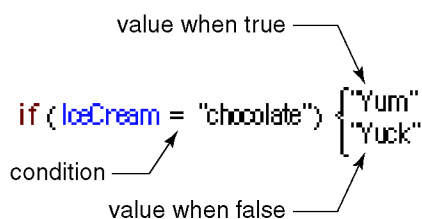
- The comparison operators =, <, and > can be found on the formula editor's keypad. You can also find ≤, ≥, and ≠ on the keypad by pressing **Ctrl** (Win) **Option** (Mac). You can also enter all of these from the computer keyboard.
- Express the *not* of an expression (the negative of an expression) by positioning the cursor in front of the expression and clicking the **not** key on the formula editor keypad.
- You can use *and* and *or* to string logical expressions together. Click the buttons on the formula editor keypad to enter these. Typing the words from the computer keyboard does not work.
- Some keyboard shortcuts: **&** for *and*, **Ctrl+Shift+O** for *or*, and **~** for *not*.
- When in doubt about which expressions are evaluated first, use parentheses to force the evaluation order you want.
- *True* and *false* are allowed values for attributes, so you can enter a formula for an attribute that returns a Boolean value.

Make If- and Switch Statements

Many times you would like the value of an attribute to depend on whether something is or is not true of another attribute. That's when you use an if-statement. If you have more than two possibilities, use a switch statement.

If-Statements

An if-statement has three parts: the condition, the value when the condition is true, and the value when the condition is false.



To create an if-statement,

1. Type `if (` . As shown below, TinkerPlots fills in the other parenthesis, the brace, and a question mark for each of the values to be entered.

```
if ( ) { ?
    }
```

Or,

1. Open the function list to the **Conditional** category and double-click *if*.

You can create nested if-statements by using if-statements as values for if-statements.

```
if (IceCream = "chocolate") {
  if (sauce = "fudge") { "Wow!"
    "Eat it"
  }
  if (hour > 8) { "Eat it anyway"
    "Pass"
  }
}
```

Switch Statements

Switch statements are very helpful for [recoding data](#). Switch statements, unlike if-statements, can deal with more than two possibilities.

There are three parts to a switch statement: the value to switch on, the test values, and the result values. Usually you will write switch statements similar to the one shown here. Your value to switch on will be the name of an attribute, the test values will be values that the attribute takes on, and the result values will amount to a recoding of the original attribute. TinkerPlots returns the result value whose test value matches the value being switched on.

test values ————— result values

```
switch (flavor) {
  ("chocolate") : "good"
  ("vanilla")   : "OK"
  ("strawberry") : "yuck"
  else          : "neutral"
}
```

value to switch on ————

A switch statement's tests are not limited to equality. In the statement below, for example, TinkerPlots first compares the value of *N* with 0 and returns "zero" if *N* does equal 0. If not, it tests to see whether *N* is less than 5 and returns "low" if it is. If not, it goes on to compare *N* with 10 and returns "medium" if *N* is less than 10. If no test has succeeded thus far, it returns "high."

```
switch (N) {
  (0) : "zero"
  (? < 5) : "low"
  (? < 10) : "medium"
  else : "high"
}
```

Here are the rules to keep in mind when writing switch statements.

- If you do not explicitly specify a comparison operator, TinkerPlots will test for equality.
- TinkerPlots returns the first result value whose test returns true. The fact that later tests might also return true has no effect on the result.

- A switch value can itself be an expression, not just the name of an attribute, for example, $\frac{circum}{diameter}$. The result of evaluating the expression is used in the test.

```
switch (  $\frac{circum}{diameter}$  ) {
  ( ? <  $\pi$  ) : "less than"
  (  $\pi$  )      : "equal"
  else       : "greater than"
```

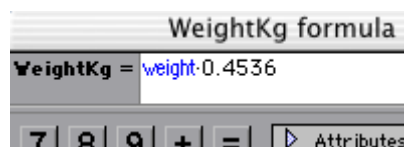
- Result values may be any expression (including if- or switch statements).
- The switch value is substituted for any question marks or missing arguments to functions that appear in the test expression.

Common Uses of Formula-Defined Attributes

Here we describe several common uses of formula-defined attributes.

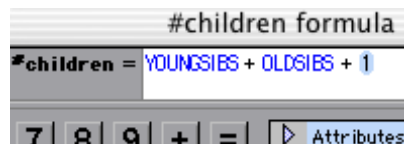
Convert Measurement Units

You may want to change the unit of measurement of a numeric attribute, for example, feet to meters. In the data set **Backpacks.tp**, the attributes *BodyWeight* and *PackWeight* are both given in pounds. You might want to convert these to some other unit, such as kilograms. A pound is equivalent to 0.4536 kilograms, so you can create a new attribute by using the conversion formula.



Create Derived Attributes

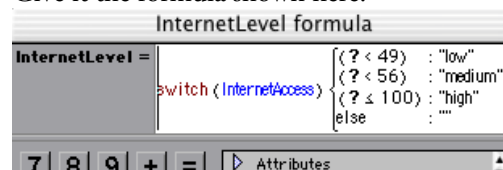
Often it's helpful to create new attributes from existing ones. For example, the data set **US Students.tp** includes attributes for the number of older siblings (*OLDSIBS*) and younger siblings (*YOUNGSIBS*). From these we created the new attribute *#children* by using this formula.



Recode Numeric Values to Categories

Sometimes it's useful to make a category attribute from a numeric one. For example, in the data set **US States.tp**, the numeric attribute *InternetAccess* shows the percentage of people in each U.S. state who have Internet access. We created a new attribute that divides the states into three groupings: states with low Internet access (below 49%), states with medium Internet access (49% to 55%), and states with high Internet access (56% to 100%). To do this,

1. Define a new attribute called *InternetLevel*.
2. Give it the formula shown here.



The switch function is very useful for doing this kind of recoding. In this case, the switch function starts from the top and substitutes the attribute *InternetAccess* for ? in each of the

expressions, searching for an expression that is true. When it finds one, it stops and returns the value to the right of the colon for that expression. By specifying “else” as “” at the bottom of this list we accounted for the possibility that one or more of the cases might have a missing value.

Tips for entering this formula:

- You do not type the ? characters; TinkerPlots enters them for you when you start typing the characters into the parentheses.
- To enter \leq , press **Ctrl** (Win) **Option** (Mac) and click the \leq button on the formula editor keypad.
- To get a new line in the switch statement, press the **Insert** key on your computer keyboard (**Command+Option+Return** also works on a Macintosh).
- Remember to put the category values, like “low,” in quotes.
- If you get too many lines in your switch statement, you can get rid of them by pressing the **Delete** or **Backspace** keys until there is nothing left in the line.

Recode Missing Values

Most real-world data have missing values. TinkerPlots treats empty values (nothing in the cell) as missing. Unfortunately, there is no standard way for coding missing data, so you’ll often import data that uses an asterisk * for missing data, or the word “missing.” For TinkerPlots to treat these as missing, you’ll need to recode the data.

Suppose, as shown in the left column of this case table, that an attribute named *thickness* has missing values coded as asterisks, *.

thickness	thicknessRecode
4	4
3	3
2	2
4	4
*	
2	2
1	1

We want to recode the asterisks as empty values and leave everything else intact. To do this,

1. Make a new attribute named *thicknessRecode*.
2. Give it the formula below.

$$\text{if (isNumber (thickness)) } \begin{cases} \text{thickness} \\ "" \end{cases}$$

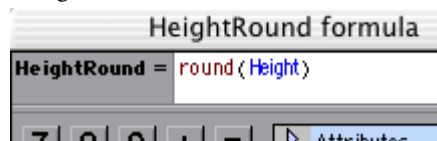
You can see the result in the second column of the case table. The formula says that if the value of *thickness* is a number, then keep that value. But if the value of *thickness* isn’t a number, then replace that value with nothing (“”).

If you want, you can then delete the formula for *thicknessRecode*, and then delete the original *thickness* attribute. You might then rename *thicknessRecode* to *thickness*.

Round Data

Many data sets include attributes with decimal values. You may want, however, to use one of these data sets with students who have not yet learned about decimals. If the data set is short, you could edit values by hand. But if the data set is longer, it would be quicker to create new attributes using the *round* function.

For example, in the data set **Dinosaurs.tp**, the attribute *Height* includes decimal values. You could make a new attribute, *HeightRound*, that rounds values of *Height* to the nearest whole number by using this formula.



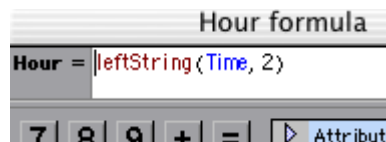
After creating the new attribute, you would probably want to remove the original attribute. To do this, first open the formula for *HeightRound* and delete it. This will leave the computed values in place. Now you can delete the attribute *Height*. You might also want to change the name of the new attribute from *HeightRound* to just *Height* and perhaps [move it from the bottom of the data card](#) to where the original attribute was.

Note that you can specify the number of decimal places to round to. Entering `round(height, 1)` would round the values to one decimal place.

Transform Time-Coded Data

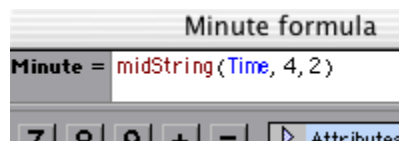
Often when you download data with a time attribute, the times will be represented as a string. For example, 08:04:55 means 8 AM, 4 minutes, 55 seconds. Because values in this attribute contain non-numeric characters (the colons), TinkerPlots will consider this a category attribute. There are a number of different ways to recode such time data to make them numeric, and which you use will depend on what information you want to keep and in what form. You may want three attributes: *Hour*, *Minute*, and *Second*, or you may want to convert the times into decimal hours. In either case,

1. Suppose your original attribute is called *Time*. Create three new attributes: *Hour*, *Minute*, and *Second*.
2. For the attribute *Hour*, enter the following formula into the formula editor.



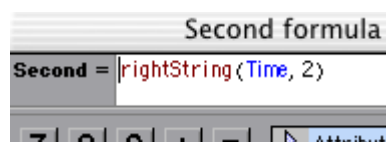
The function *leftString* in this case begins at the beginning of each value of *Time* and returns the first two characters, which is the hour.

3. For the attribute *Minute*, enter the following formula into the formula editor.



The function *midString* starts at, in this case, the fourth character in the string and returns it and the next character (in the formula, the 4 after *Time* is the beginning point, and the 2 says how many characters to go to the right).

4. For the attribute *Second*, enter the following formula into the formula editor.



The function *rightString* begins at the end of the string and returns, in this case, the first two characters.

Here is an example of what your data might now look like, with the original attribute, and the three newly created attributes.

Time Data				
	Time	Hour	Minute	Second
1	08:04:55	8	4	55
2	09:13:02	9	13	2
3	10:01:34	10	1	34
4	10:56:44	10	56	44
5	11:27:24	11	27	24

You might now want to make a single time attribute that gives the hour and fraction of the hour in decimal form. To do this,

1. Create a new attribute, *Time2*.
2. Define *Time2* using the following formula.

Time2 formu

$$\text{Time2} = \text{hour} + \frac{\text{minute}}{60} + \frac{\text{second}}{3600}$$

In an hour, there are 60 minutes or 3600 seconds, so this formula gives you a measure of time expressed in hours only, where the decimal portion tells you the fraction of the hour. In this format, 30 minutes would be expressed as 0.50 hour. Here's what the case table would look like now.

Time Data					
	Time	Hour	Minute	Second	Time2
1	08:04:55	8	4	55	8.08194
2	09:13:02	9	13	2	9.21722
3	10:01:34	10	1	34	10.0261
4	10:56:44	10	56	44	10.9456
5	11:27:24	11	27	24	11.4567

You may want now to delete all the other time attributes except *Time2*. However, you'll first need to delete the formula for *Time2*. To do this,

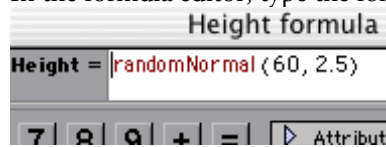
3. In the data card, double-click the blue formula circle for *Time2*.
4. Highlight the formula in the formula editor, then press **Delete**.
5. Click **OK**.

Deleting the formula for *Time2* leaves its values in place, but they will no longer be dependent on the other attributes. If you tried first to delete one of the attributes that *Time2* uses in its formula, TinkerPlots wouldn't know how to compute values for *Time2*.

Create Realistic Data

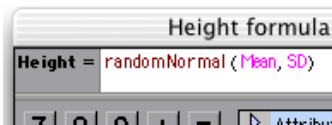
TinkerPlots has a lot of functions you can use to make up data for instructional purposes. Suppose, for example, you want sample data that are approximately normally distributed with a particular mean and standard deviation. You can quickly generate a large sample using the function *randomNormal*. Here, for example, is how you'd make a group of 100 students who were 60 inches tall on average with a standard deviation of 2.5 inches.

1. Create a new data set by dragging a stack of data cards into the document.
2. In the data cards, enter the attribute name *Height*.
3. Choose **New Cases** from the **Data** menu.
4. In the dialog box, enter the number of new cases to add and click **OK**.
5. In the data cards, double-click the circle in the **Formula** column. (If you can't see the **Formula** column, widen the data cards by dragging the right edge.)
6. In the formula editor, type the following formula and click **OK**.



TinkerPlots will assign random values to the 100 cases by randomly drawing from a normal distribution with mean of 60 and standard deviation of 2.5.

Rather than entering fixed values for a function like this, you could enter the names of sliders in their place. With the *randomNormal* function, for example, this would allow you to dynamically change both the value of the mean and the standard deviation and watch the data in the graph change as you do it. To enter slider values into the above attribute formula, you'd create two sliders, one named *Mean* and the other *SD* (see [Make a Slider](#)). In the formula editor, you'd enter these slider names instead of values. In this case, here is what the formula would look like.



The **Data and Demos | Demos** folder contains several files that use this approach to create realistic data that you can manipulate with sliders to make up data of various kinds. See, for example, **Sample Means Demo.tp** or **Medical Test Demo.tp**.

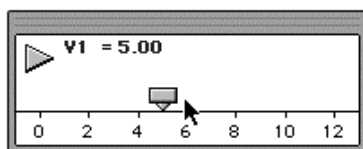
Working with Sliders

A *slider* is a named value that you can use in the formulas of attributes and of plot filters. You can dynamically change a slider's value and thus the data values dependent on it. See [Common Uses of Sliders](#).

Make a Slider

1. Drag the slider from the object toolbar (upper left of window) into the document.

By default, sliders are named *VI*, *V2*, etc., have an initial value of 5, and have an axis that goes roughly from 0 to 12, as shown here. On this slider, the cursor is near the slider's "thumb." Drag the thumb to change the slider's value, or click the arrow to animate the slider.



Rename a Slider

1. Double-click the name (*VI*) and type a new one. Then press **Enter**.

Tip: Use meaningful slider names to make it clear what purpose each slider serves. Each name must begin with a letter and contain only letters, numbers, or underscores (_). Any invalid characters are removed when you press **Enter**.

Change a Slider's Value

1. Drag the slider thumb to a new position on the axis.

Or,

1. Double-click the numeric value to the right of the equal sign and type a new value. If necessary, the axis will change to include the value.

Change a Slider's Scale

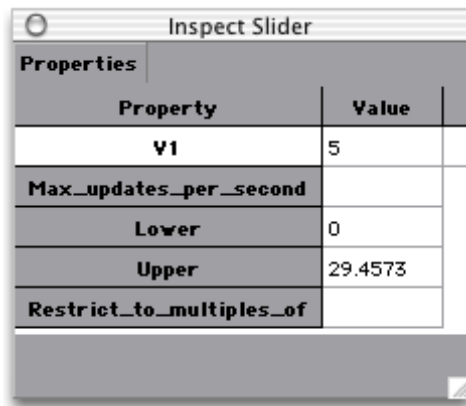
To change the scale of a slider axis,

1. Move the cursor over the axis. The cursor will turn into a hand icon.
2. Move the hand either to the center of the scale or to one of the ends. In the center, the fingers of the hand will point up. Towards the ends of the axis, the fingers will point to the right (right end of scale) or to the left (left end of scale).
3. Click and drag to adjust the axis. Pulling from the center (fingers up) will translate the axis, moving it left or right without changing the scale. Pulling in or out from one of the axis ends will rescale the axis, making the axis values either closer together or farther apart.

Or,

1. Double-click the axis to bring up the **Inspect Slider** window, shown here.
2. Enter new values for **Lower** or **Upper** to change the axis endpoints.

- Click the close button to close the window.



Animate a Slider

- Click the arrow button on the slider (to the left of its name). The button changes to an **x** button. Click again to stop animation.



The slider thumb will move back and forth between the ends of the slider axis, and the value corresponding to the slider will change accordingly. Any formula containing the slider's name will be recalculated and all views of it will update. The direction the slider goes first depends on the direction it was last moving. If you want it to first animate to the right, move it manually to the right before you start the animation.

While an animation is taking place, you can do other things in TinkerPlots, but the response might be a bit slow. You can slow down animation by making the slider wider, or speed it up by making it narrower. You can also change its speed by entering a value for **Max_updates_per_second** in the **Inspect Slider** window. To open this window, double-click the slider axis. Higher numbers speed up the animation.

Restrict Slider Values

You may want a slider to allow only certain values, integers for example. To restrict slider values,

- Double-click the slider axis to open the **Inspect Slider** window.
- Enter a value into the **Value** column for **Restrict_to_multiples_of**. Entering the value 1 creates an integer slider, entering 10 creates a slider that gives only multiples of 10 as its values—even when you animate or drag the slider.

Use a Slider in a Formula

You can refer to a slider's value in any formula. When you create the formula, either type the slider's name, or double-click its name in the Global Values list in the formula editor.

Common Uses of Sliders

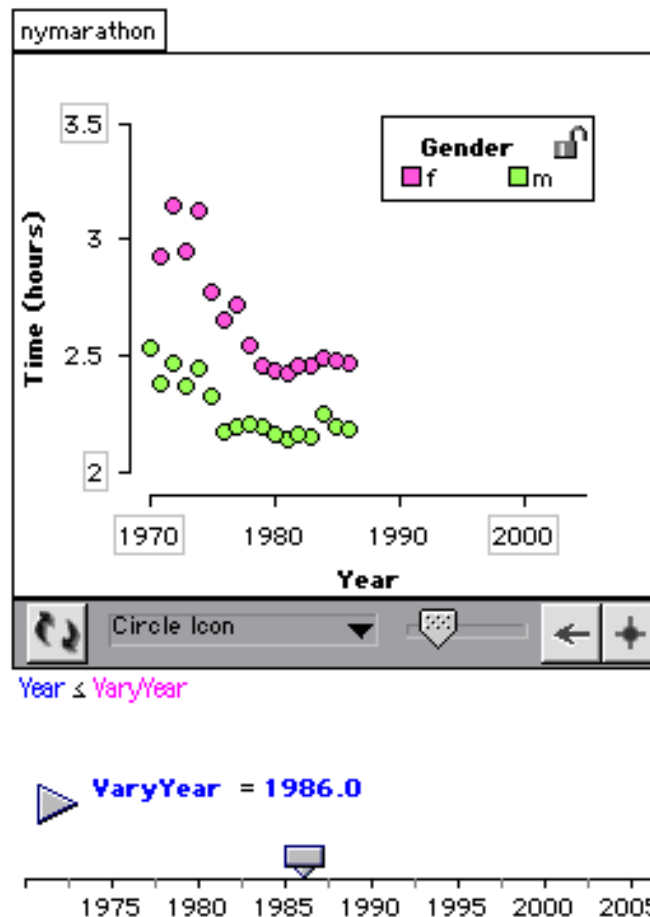
Here we describe a few possible uses of sliders in TinkerPlots. The folder **Data and Demos | Demos** includes several TinkerPlots files that use sliders in various ways. As you'll see in those documents, sliders are easy to use once they have been created. But useful sliders are not so easy to set up in the first place. Thus sliders are not things that students themselves should in general be figuring out how to construct. Rather, they are resources for teachers and curriculum designers to use in creating data sets and activities for students.

Animate Time Series Data

Many data are collected over time. For example, the data set **NY Marathon.tp** includes the running times for the male and female winners of the New York City Marathon from 1970 through 2004. Plotting data such as these over time often reveals interesting patterns and trends. You can use plot filters and sliders to “re-enact” such events that occur over time. This allows you to add data to the plot over time. Results are much like time-lapse photography. These time animations can help students learn how to read time series plots (by scanning visually from left to right along the time axis). The animations can also help you detect subtle patterns in the data that are hard to see when you view them all at once.

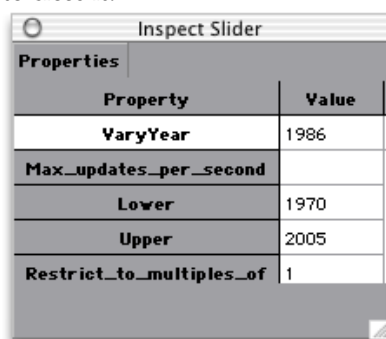
To create a slider that allows you to add data to a plot in the order they were collected,

1. *Make a time series graph*, putting the time attribute on the horizontal axis and the attribute you want to view over time on the vertical axis. Fully separate each attribute.



2. *Create a slider that will control time* (in this case, *Year*). To do this, drag a slider from the object toolbar (upper left of window) and drop it where you want in the document. Here it is right below the plot. By default, the name of the slider will be *VI*. Double-click the *VI* and rename the slider (in this case, *VaryYear*).
3. *Set the slider axis*. Double-click the slider axis to open the **Inspect Slider** window. Set the **Lower** and **Upper** values so that they include the full range of your time attribute. Because the values of *Year* are integers, enter 1 into the value for **Restrict_to_multiples_of**. Now the

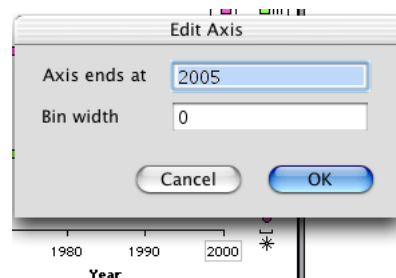
slider will take on only integer values. Click the close button of the **Inspect Slider** window to close it.



4. *Add a filter to the plot.* With the plot selected, choose **Add Filter** from the **Plot** menu. Type a formula that will allow you to control the cases that appear in the plot with the slider. After you've entered the formula, click **OK**.

This example shows the filter formula $Year \leq VaryYear$. The formula instructs TinkerPlots to include in the plot only the values of *Year* that are less than or equal to the current value of the slider *VaryYear*. To enter \leq , press **Ctrl** (Win) **Option** (Mac) and click the \leq button on the formula editor keypad.

5. *Set the plot axis.* To prevent the plot axis from automatically rescaling as data are added or removed, click the upper value of the time-based plot axis and set the axis endpoint to some value that is greater than the maximum data value.



6. *Use the slider to control the plot.* Do this either by dragging on the slider's thumb or by clicking the arrow next to the slider name to animate the slider. Click the red **X** to stop the animation.

In this example, when you add the data to the plot over time, you clearly see that the winning times for males and females tend to go up and down together from year to year, perhaps reflecting the effect of weather conditions on run-times. This relationship is not as easy to detect when all the data are on the graph at once.

Grow a Sample

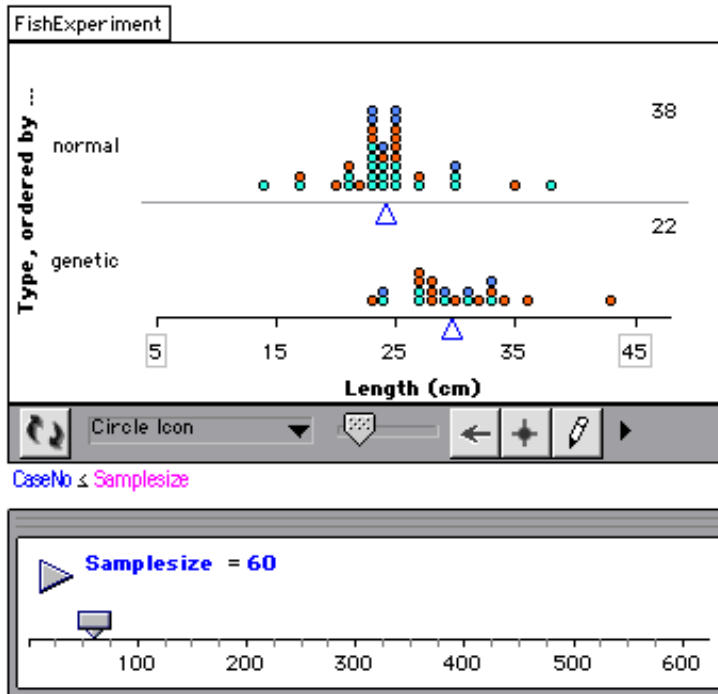
When looking at a sample to explore a particular question, students will often ask, "But what would happen if we collected more data?" One way to let young students explore this question is to "grow" samples—to randomly draw cases from a larger population and observe how the sample changes, and doesn't change, as it gets larger. Though you can do this with real data, the example here uses made-up data.

Open the demonstration document **Fish Experiment Demo.tp** to see the data. The cover story involves a fish farmer who has stocked a pond with both normal fish and a new type of genetically altered fish that is supposed to grow longer than the normal fish. To test this claim, the farmer catches the matured fish from the pond and measures them. The demonstration

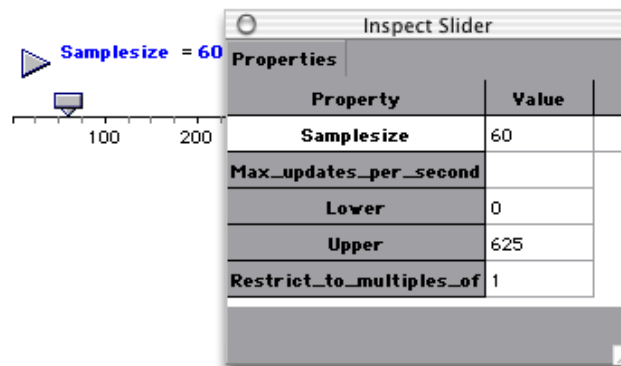
allows you to capture data from the collection and display it in a plot. Use the slider beneath the plot to gradually increase the sample size until, if you want, you can view all 625 fish in the pond.

When students in grades 4–6 have used these data both on and off the computer, they have come to observe that even when their sample is still relatively small, certain features of the larger population are usually already evident, such as where the data tend to be centered.

The following steps describe how this document was set up using sliders, filters, and attribute formulas.

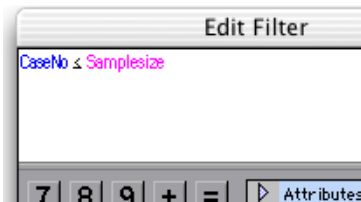


1. *Create a slider that will allow you to add data to the plot.* To do this, drag a slider from the object toolbar (upper left of window) and drop it where you want in the document. Here it is below the plot. By default, the name of the slider will be *V1*. Double-click *V1* and rename the slider, (in this case, *Samplesize*).
2. *Set the slider axis.* Double-click the slider axis to bring up the **Inspect Slider** window, as shown. Set the **Lower** and **Upper** values to cover the range of the number of cases, in this example from 0 to 625. Enter 1 into the value for **Restrict_to_multiples_of** so that the slider will take on only integer values. Click the close button of the **Inspect Slider** window to close it.

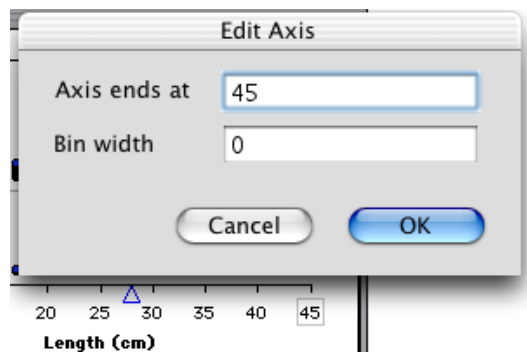


3. *Add a filter to the plot.* With the plot selected, choose **Add Filter** from the **Plot** menu. Type a formula that will allow you to control the cases that appear in the plot with the slider. After you've entered the formula, click **OK**.

This example shows we entered the formula $CaseNo \leq SampleSize$. The attribute *CaseNo* ranges from 1 to 625, and each case has a unique number. This filter formula instructs TinkerPlots to include in the plot only the values of *CaseNo* that are less than or equal to the value of the slider *SampleSize*. Thus by adjusting this slider, you can grow the sample all the way from 0 case to 625 cases. (To enter \leq into the formula editor, press **Ctrl** (Win) **Option** (Mac) and click the \leq button on the formula editor keypad.)



4. *Set the plot axis.* To prevent the plot axis from automatically rescaling as new values are added, click the upper end of the plot axis. In the dialog box, enter the value 45 even though it was already set to this value. By retyping it into the dialog box, you lock that end so it won't change. Do the same for the lower end of the axis, setting it to be below the minimum value of the data.



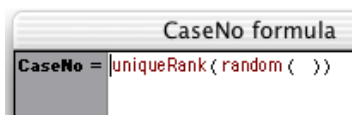
5. *Use the slider to control the number of cases in the plot.* Do this either by dragging on the slider's thumb or by clicking the arrow next to the slider name to animate the slider. Click the red **X** to stop the slider animation.

In this example, the attribute *CaseNo* was created using a formula that allows you to quickly reassign case numbers to the 625 values. Thus you can redo this experiment over and over, seeing what happens if the fish happened to be sampled in a different order.

To randomly assign new values of *CaseNo* to the cases,

1. Choose **Rerandomize** from the **Data** menu.

If you have data in the graph, you'll see it change location as a new sample of fish are "caught." Here's the formula for *CaseNo* we use to do that.



The formula combines two functions. The inner-most function, *random()*, randomly assigns each case a real number from 0 to 1 (the default range for this function). So each case in the data set

gets some value such as 0.56779. The function *uniqueRank* then takes these random numbers and assigns them a unique ranking from 1 to 625 (the number of cases we have) based on their value. If two or more of the cases happened to have random numbers of the same value, which would be extremely unlikely, the function *uniqueRank* will arbitrarily give them unique rankings anyway. This is all just a complicated way of randomly reordering the 625 cases and giving them a number based on this ordering.

Create a Random Sample

Sometimes data sets you'll download from the Internet will be much larger than you want. You could, of course, just delete a bunch of the cases. However, cases are often not entered into a data set in random order, so keeping only, say, the first 200 cases may give you a biased sample.

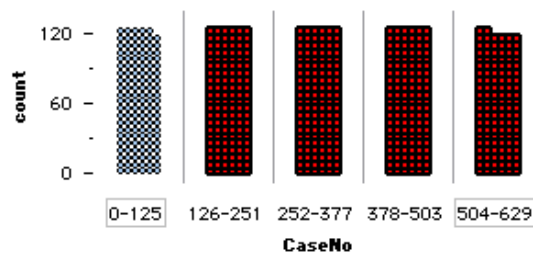
To create random samples from a larger data set, you follow the same basic procedure described in [Grow a Sample](#). The advantage of using this approach is that you won't need to throw away any of the data if you don't want to. Rather you set it up so that you can look at random samples of the data, and these samples can be of any size you choose. But before you can draw samples as described in Grow a Sample, you'll first need to create a new formula-defined attribute in the data card. Here's how.

1. In the data cards, click **<new attribute>** at the bottom of the data cards and enter a name such as *CaseNo*.
2. Double-click the circle in the **Formula** column for this new attribute. (If you can't see the **Formula** column, widen the data cards by dragging the right edge.)
3. In the formula editor, enter the formula *uniqueRank(random())* and click **OK**. See [Enter a Formula](#) for help.

This formula assigns a random set of case numbers to all of your cases.

If you do want to delete some of the cases after creating a random ordering, here's how to do it.

1. In a plot, separate the cases according to the attribute that assigns cases a random order. This is the attribute *CaseNo* in our example.
2. Make bins so that the label at the right of one of the bins is the same as the number of cases you want to keep.
3. Select the cases you want to delete from the data set by drawing a marquee around those cases. In the example below, we've selected all of the cases with values of *CaseNo* greater than 125. The color gradient is off so that you can clearly see the selected cases, but it doesn't need to be.



4. In the data cards, click the gray circle at the top of the data cards. (If you click somewhere else in the data cards, you will deselect the cases.)
5. Choose **Delete Cases** from the **Edit** menu. The selected cases will be removed from the data set.
6. Choose **Save As** from the **File** menu to save this new, smaller data set as well as the original one with all the data. Choose **Save** from the **File** menu to replace the original data set with this new one.

Create Realistic Data

You can use a slider along with formula-derived attributes to create and quickly modify hypothetical data. See [Create Realistic Data](#) in the section Common Uses of Formula-Defined Attributes.

TinkerPlots Objects

There are six different kinds of objects you can place in a TinkerPlots document: data cards, case tables, plots, sliders, text, and pictures.

You can create a new object by dragging its icon off the object toolbar located in the upper-left corner of the TinkerPlots window. Place the object in the document where you want it to appear. Reposition an object by dragging it by its top bar. Resize an object by dragging from a corner or edge.

Several objects have their own menu in the menu bar at the top of the window. These menus are visible only when the object is selected.

Most objects also have a contextual menu that you can activate by right-clicking (Win) or by pressing **Control** and clicking (Mac).

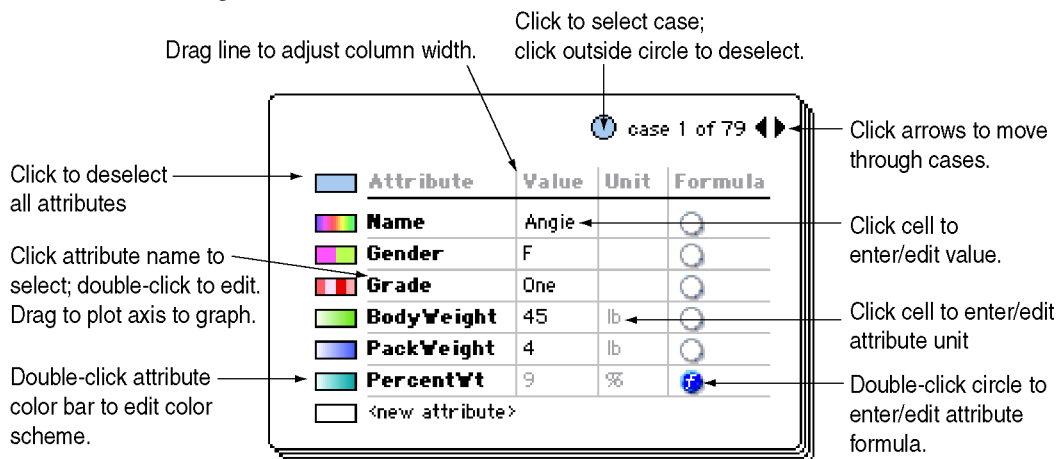
Delete an object by selecting it and then choosing **Delete [object name]** from the **Edit** menu or by using the keyboard shortcut **Del** (Win) **Command+D** (Mac). You can also temporarily hide objects by choosing **Hide [object name]** from the **Edit** menu and bring them back into view by choosing **Show Hidden Objects** from the **Edit** menu.

You can turn most objects into icons by dragging from the lower-right corner all the way up and left. Turning an object into an icon allows you to move large objects temporarily out of the way. When you want to see the object again, enlarge it by dragging a corner.

You can place any object in its own, floating window by choosing **View In Window** from the **Window** menu.

Data Cards

In TinkerPlots, data sets are stored in a stack of data cards. With data cards you can see one case at a time, add or change data, drag attributes into plots, and change the color scheme of attributes. You can use other objects, namely case tables and plots, to see your data displayed in other ways. If you delete a case table or plot, the data remain in the data cards. But if you delete the data cards, the data are gone.



- Press **Tab** to move down a column of values or units. When you're at the bottom row, **Tab** moves you to the next data card.
- Press the **Home** key to go to case 1; press the **End** key to go to the last case.
- Drag the lower-right corner to resize the stack.

Attributes in Data Cards

- To make a plot using an attribute, drag that attribute's name to a plot axis.
- To select an attribute, click that attribute's name. When an attribute is selected, the icons in a plot are colored with that attribute's color scheme.
- To change an attribute's color scheme, double-click the color bar next to that attribute's name.
- To deselect all attributes, click the light blue color bar at the upper left of the data cards. Clicking here also colors all case icons the same, light blue color. This is especially useful for seeing highlighted icons in the plot, as highlighted cases will be colored red.
- To add a new attribute, double-click in the bottom row labeled **<new attribute>**.
- To rename an attribute, double-click its attribute name.
- To delete an attribute, click it once to select it. Then choose **Delete Attribute** from the **Edit** menu.
- To insert an attribute in a particular position, select the attribute in the row below where you want the new one to appear, then choose **New Attribute** from the **Data** menu.
- To enter or edit the unit name of an attribute, click in a cell in the **Unit** column.
- A blue circle in the **Formula** column indicates an attribute that is computed by formula. Double-click the blue circle to see or edit the formula. Double-click a white circle to create a formula for an attribute.

Cases in Data Cards

- To bring a particular case to the top of the stack, click the arrows in the upper-right corner; or click the case's icon in a plot.
- To select a case, click the colored circle at the upper right of a card; click next to the circle to deselect the case.
- To enter data for a new case, go to the last card in the stack. (Press the **End** key to go directly to the last card.)
- To edit data for a case, click a cell in the **Value** column and enter the new value.
- To delete a case, click the colored circle at the top of the card to select the case. Then choose **Delete Case** from the **Edit** menu.
- To enter or edit the attribute value of a case, click a cell in the **Value** column.

Case Tables

Case tables display data in a table format, with attribute names along the top of the table and each case in a separate, numbered row. With a case table you can see multiple cases at once, add or change data, drag attributes names into plots, and sort your data.

Click attribute name to select;
Double-click to edit; Drag to
plot axis to graph.

Drag line to adjust
column width.

Double-click to
enter/edit attribute
formula.

Click to enter
new attribute.

	Name	Gender	Grade	BodyWeight	PackWeight	PercentWt	<new>
=						$\text{round}\left(\frac{\text{PackWeight}}{\text{BodyWeight}} 100\right)$	
1	Angie	F	One	45	4	9	
2	Sam	F	One	46	4	9	
3	Julie	F	One	32	3	9	
4	Kim	F	One	47	3	6	
5	Doris	F	One	60	7	12	

Click to select case.

Click cell to
enter/edit value.

Scroll to see
additional cases.

- Press **Tab** to move to the next cell; press **Enter** to move down one row.
- To see the formula row (as above), choose **Show Formulas** from the **Table** menu.
- Resize the formula row by dragging the bottom of its row.

Attributes in Case Tables

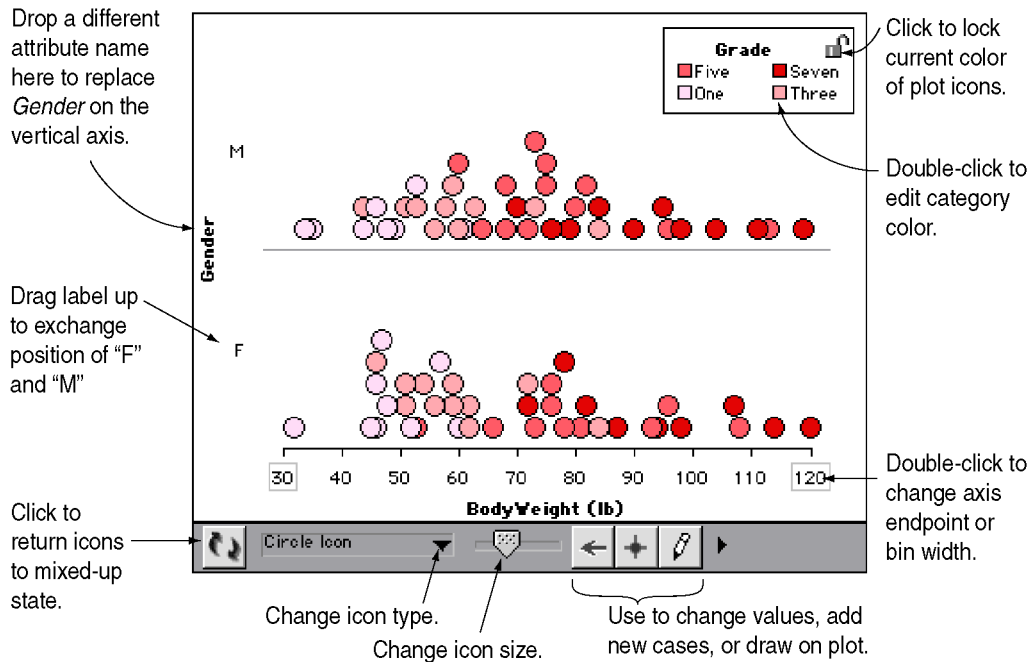
- To make a plot using an attribute, drag that attribute's name to a plot axis.
- To select an attribute, click that attribute's name. When an attribute is selected, the icons in a plot are colored with that attribute's color scheme.
- To add a new attribute, click the cell labeled **<new>**.
- To change where an attribute appears, drag the attribute name to new location.
- To rename an attribute, double-click its attribute name.
- To hide an attribute in a case table, select the attribute by clicking it, then choose **Hide Attribute** from the **Table** menu; to display hidden attributes, choose **Show Hidden Attributes** from the **Table** menu.
- To delete an attribute, click it once to select it, then choose **Delete Attribute** from the **Edit** menu.
- To insert an attribute in a particular place, select the attribute to the right of that place, then choose **New Attribute** from the **Data** menu.
- Edit the formula of an attribute by double-clicking the current formula in the **Formula** column.

Cases in Case Tables

- To select and highlight a case, click its row number.
- To enter data for a new case, go to the last row in the table and enter values for the case.
- To edit data for a case, click the appropriate cell and enter the new value.
- To delete a case, select it by clicking its row, then choose **Delete Case** from the **Edit** menu.

Plots

Use plots to organize your data graphically to search for interesting patterns or group differences. Here we mention some of the more general things you can do in plots. See [Working with Plots](#) for more detailed information.



- Click an icon to select it. This will also bring that case's data card to the top of the stack and will highlight that case in a case table or in another plot.
- To remove everything from a plot and start over, click the **Mix-up** button on the toolbar on the bottom of the plot.
- Improve the appearance of a plot by resizing it (drag a corner) or by resizing the plot icons (adjust slider on lower controls).
- To add an attribute to one of the plots' axes, drag the attribute name from a data card, a case table, or another plot and drop it on either of the axes.
- For numeric attributes, drag any icon to the right (or up) to make up to eight bins. To make fewer bins, drag an icon to the left (or down).
- Drag a bin line of a numeric attribute to the left (or down) to make more, narrower bins. Drag to the right (or up) to make fewer, wider bins.
- For category attributes, drag a case in any direction to separate out all cases with that value from the rest of the cases.
- Choose one of several icon types from the **Icon Type** menu on the lower plot toolbar.
- Double-click on either endpoint of an axis to change that endpoint and/or the bin width. To restore the default axis values, redrag the attribute from the data cards onto the axis.
- Some plot features, such as dividers and hat plots, only appear on fully separated plots—plots that have no bin divisions and a continuous, numberline axis.
- Choose **Swap Axes** from the **Plot** menu to switch the attribute on the vertical axis with the attribute on the horizontal axis.
- To remove attribute colors from the plot icons, click the light blue bar in the upper left of the data cards.

- To prevent a plot's color from changing, select the plot and click the **Key** button on the upper plot toolbar. Close its lock by clicking it.
- Choose **Hide Selected Cases** from the **Plot** menu to remove highlighted cases from the plot. You can use this multiple times to exclude more and more cases.

Sliders

Sliders are explained in [Working with Sliders](#).

Text

Text boxes are useful for documenting your work. You can put a text box next to a plot to serve as a caption or short description of what the plot says. There's no limit to how much you can write in a text box. See the demonstration document **Backpack Report.tp** for an example of how you can use text boxes and other TinkerPlots objects to make a project report.

To format text, go to the **Text** menu, where you can choose text font, size, and style, or choose **Show Text Palette**, which gives you all these options and more. In Windows, the text palette appears docked, on the bottom of the screen; on the Macintosh, it floats.



Use the rightmost button on the text palette to expand it to show special symbols and formatting tools. Clicking a button places the special character in the cursor insertion spot.

Pictures

You cannot make drawings in TinkerPlots, but you can paste in pictures. If you are writing your report in TinkerPlots, this is a good way to include useful illustrations and photos.

1. In some other application, copy a picture onto your clipboard.
2. Make sure that nothing is selected in your document. (Click in an empty area to deselect all objects.)
3. Choose **Paste Picture** from the **Edit** menu.

You can resize the picture just as you would any other object in TinkerPlots by dragging the edges of its frame.

You can also copy and paste pictures of TinkerPlots objects into a TinkerPlots document (for example, if you want several, static graphs that can't be changed).

1. Select the object.
2. Choose **Copy Picture** from the **Edit** menu.
3. Click in an empty area of the TinkerPlots document (to deselect all objects).
4. Choose **Paste Picture** from the **Edit** menu.

Operators and Functions in the Formula Editor

Here are the operations and functions currently supported in the TinkerPlots formula editor. Because many of these are inherited from [Fathom](#), they may not be very useful in middle school. However, because it's very hard to predict when one might come in handy, we chose to leave most of them in TinkerPlots.

Operators

- **Arithmetic operators:** +, -, *, /, ^ (Shift+6), !
These obey normal algebraic precedence, but you can use parentheses when in doubt. The ^ operator raises to a power, and the ! operator computes the factorial of a number.
- **Logical operators:** and, or, not
Click the keypad buttons on the screen to enter these. (You can type these operators if you are careful about using parentheses.)
- **Comparison operators:** <, >, =, ≠
These are available on the keypad. You can also type <, >, or = from the computer keyboard. To type ≠, press **Ctrl** (Win) **Option** (Mac) and type =.
- **Comparison operators:** ≤, ≥
Enter these by pressing **Ctrl+Shift** (Win) **Option+Shift** (Mac) while typing > or <, or by pressing **Ctrl** (Win) **Option** (Mac) while clicking the buttons on the on-screen keypad.

Arithmetic Functions

<i>abs</i>	Use either the function, as in <i>abs(first – second)</i> , or use the vertical bar button, on the keypad, or press the key on your computer keyboard.
<i>combinations</i>	Returns the number of combinations of <i>n</i> things taken <i>k</i> at a time. For example, <i>combinations</i> (5,2) is 10.
<i>exp</i>	Exponential function (“ <i>e</i> -to-the . . .”).
<i>floor</i>	Truncates to the next integer toward zero.
<i>ln</i>	Natural logarithm.
<i>log</i>	Common (base-10) logarithm.
<i>modulo</i>	Returns the remainder after one number is divided by another; <i>modulo</i> (11, 4) returns 3.
<i>round</i>	By default, rounds to the nearest integer. <i>round</i> (<i>AttributeX</i> , 2) rounds values of <i>AttributeX</i> to the nearest hundredth.
<i>sgn</i>	Signum function (+1 if the number is greater than 0; –1 if it's less than 0; 0 if it's 0).
<i>sqrt</i>	Gives the square root of its numeric argument.
<i>trunc</i>	Truncates, that is, lops off the decimals.

Conditionals

if Creates an “if” block. If the expression in parentheses after *if* is true, the formula returns the upper value; if not, it returns the lower. The example below returns “big” if the value for *xx* is greater than 2 and “small” otherwise.

```
if (length > 2) { "big"
                  "small" }
```


switch

Acts like a sophisticated *if*, and is very useful for recoding attributes. It takes an optional expression inside parentheses and then evaluates each of any number of true/false expressions to determine which value to return. This is best shown with a couple of examples.

TinkerPlots interprets the following expression by substituting *age* for ? in each of the expressions, starting at the top, until it finds one that is true. It returns the value to the right of the colon for that expression. So, if *age* is 45, the value of the entire expression is “mature.”

```
switch (age) | (? < 2) : "infant"
              | (? < 13) : "child"
              | (? < 20) : "teen"
              | (? < 30) : "young adult"
              | (? < 50) : "mature"
              | else : "wise"
```

Here’s another example, one that might be used to recode numeric data into meaningful phrases. TinkerPlots compares the value of *eduCode* with each of the numbers in parentheses and returns the expression to the right of the first one that matches. If none match, it returns the value of the expression to the right of *else*.

```
switch (eduCode) | (10) : "High school"
                  | (14) : "Bachelor's degree"
                  | (15) : "Master's degree"
                  | else : "Something else"
```

Distribution Functions

These functions, not described here, give you access to various statistical distributions. They are not currently of much use in TinkerPlots but may be useful in future versions. You can access brief descriptions of each by clicking a function’s name in the formula editor. Help text appears in the Help pane at the bottom of the formula editor.

Logical Functions

<i>even</i>	Returns true if the argument is even: <i>even</i> (10) returns true; <i>even</i> (11) returns false. If the argument is not an integer, you will get a #DOMAIN# error.
<i>exists</i>	True if the value exists for the indicated attribute. For example, <i>exists</i> (<i>pressure</i>) will be true for each case for which there is a value for <i>pressure</i> .
<i>includes</i>	Returns true if the second argument is a substring of the first (also treated as a string): <i>includes</i> (“the”, “he”) returns true; <i>includes</i> (“dancing”, “joy”) returns false; <i>includes</i> (1234, 23) returns true.
<i>inRange</i>	True when a number is in a given range. For example, <i>inRange</i> (<i>height</i> , 60, 66) will be true for people whose height is greater than or equal to 60 and less than 66. If the third argument is less than or equal to the second argument, you will get an error.
<i>isNumber</i>	True if the value is numeric. For example, <i>isNumber</i> (<i>date</i>) will be true for the value “27” but false for the value “June.”
<i>odd</i>	Returns true if the argument is odd: <i>odd</i> (15) returns true; <i>odd</i> (20) returns false. If the argument is not an integer, you will get an error.

Trigonometric Functions

All of the trigonometric functions you could want are here, plus hyperbolic functions and their inverses. They all use radians.

<i>sin, cos, ...</i>	You also get <i>tan, sec, csc, and cot</i> .
<i>asin, acos, ...</i>	Inverse trigonometric functions. You also get <i>atan, asec, acsc, and acot</i> .
<i>sinh, cosh, ...</i>	The other hyperbolic functions and their inverses are constructed the same way: by adding an <i>h</i> to the end of the name. These hyperbolic functions and their inverses are not in the list of trigonometric functions, so you must type them from the keyboard.

Random Functions

<i>random()</i>	A random number between 0 and 1.
<i>random(max)</i>	A random (real) number between 0 and <i>max</i> .
<i>random(min, max)</i>	A random (real) number between <i>min</i> and <i>max</i> .
<i>randomInteger(min, max)</i>	A random integer between its two arguments, <i>inclusive</i> . For example, <i>randomInteger(1, 6)</i> gives 1, 2, 3, 4, 5, or 6, chosen at random.
<i>randomPick(a1, a2, ...)</i>	This function gives you an element randomly chosen from a list of any number of arguments. For example: <i>randomPick(1, 2, 3, 4, 5, 6)</i> makes a die. <i>randomPick("heads", "tails")</i> makes a coin. <i>randomPick("Male", "Male", "Female")</i> gives you a population that is two-thirds "Male."
<i>randomBinomial(n, p)</i> <i>n = number of trials</i> <i>p = probability of success</i>	This function gives you a random integer from a binomial distribution. For example, <i>randomBinomial(20, 0.5)</i> gives the number of heads in 20 tosses of a fair coin.
<i>randomNormal(mu, sd)</i> <i>mu = the mean</i> <i>sd = standard deviation</i>	A random real number pulled from a normal distribution. For example, <i>randomNormal(0, 1)</i> gives you a number from a distribution with a mean of 0 and a standard deviation of 1.
<i>randomGeometric(p)</i> <i>mu = the probability of a "catch."</i> Must be between 0 and 1.	A random nonnegative integer from a geometric distribution. You can think of the result as the number of turns it takes before you "catch" the case if the probability of catching it is the argument. Catching on the first try yields 0.
<i>randomExponential(mu)</i> <i>mu = the mean. Must be positive.</i>	A random real number greater than 0, pulled from a distribution that declines exponentially (so there are more near 0, just as in the geometric distribution). The larger the argument, the shallower the curve. Some people use the reciprocal of <i>mu</i> as the argument of their exponential distributions.

Other Random Number Functions

TinkerPlots has a number of less commonly encountered random number functions, each of which returns numbers from a different distribution. These include *randomBeta*, *randomCauchy*, *randomChiSquare*, *randomF*, *randomGamma*, *randomLattice*, *randomPoisson*, and *randomT*. The help text that appears at the bottom of the formula editor will provide some guidance for using these functions.

Text Functions

<i>beginsWith</i>	Takes two arguments and returns true if the first begins with the second. For example, <i>beginsWith</i> (<i>LastName</i> , "Mc") will return true for "McBride," false for "Binker."
<i>concat</i>	Takes up to ten arguments and returns a string. For example, if a case has the value "Denise" for the attribute Name, and the value "likes dogs" for the attribute Hobby, then <i>concat</i> (<i>Name</i> , " ", <i>Hobby</i>) gives "Denise likes dogs." The arguments can be numeric or strings. You have to include an argument for the space to get a space in the caption.
<i>endsWith</i>	Takes two arguments and returns true if the first ends with the second. For example, <i>endsWith</i> (<i>LastName</i> , "er") returns true for "Binker," false for "McBride."
<i>includes</i>	Takes two arguments and returns true if the second argument is a substring of the first (also treated as a string). <i>includes</i> ("the", "he") returns true. <i>includes</i> ("dancing", "joy") returns false. <i>includes</i> (1234, 23) returns true.
<i>stringLength</i>	Returns the number of characters for each case in the specified attribute.
<i>stringToNumber</i>	Returns the first number in a value. For example, suppose you have dinosaur weights, but the values include the units, such as "14kg." <i>stringToNumber</i> (<i>DinoWt</i>) will return "14" for that case. TinkerPlots will then treat the recoded attribute as numeric (very handy for cleaning up imported data).

Statistics Functions

One Attribute

<i>count</i>	Returns the number of cases for which the expression is true. For example, <i>count</i> (<i>NumberOfPets</i> > 0) will return the number of cases for which <i>NumberOfPets</i> is greater than zero. Similarly, <i>count</i> (<i>exists</i> (<i>Gender</i>)) will return the number of cases for which the attribute <i>Gender</i> is defined. <i>count</i> () returns the number of cases in the collection. For an attribute whose values are <i>true</i> and <i>false</i> , <i>count</i> will return the number of cases for which the value is <i>true</i> .
<i>first</i>	Returns the first value in the data set for the given attribute; for example, <i>first</i> (<i>height</i>) would be 61 for a collection of people in which the first person's height is 61 inches.
<i>iqr</i>	Interquartile range, for example, <i>iqr</i> (<i>blood_pressure</i>). This function returns the value at the 75th percentile minus the value at the 25th percentile.
<i>last</i>	Returns the last value in the collection for the given attribute; for example, <i>last</i> (<i>name</i>) would be Zelda for a collection of ducks in which the last duck's name is Zelda.
<i>max</i>	Maximum value; for example, <i>max</i> (<i>age</i>).
<i>mean</i>	The arithmetic mean; for example <i>mean</i> (<i>height</i>).
<i>median</i>	The median; for example, <i>median</i> (<i>speed</i>).
<i>min</i>	Minimum value; for example, <i>min</i> (<i>salary</i>).
<i>percentile</i>	Returns the value with a given percentile. For example, <i>percentile</i> (50, <i>speed</i>) is another way to compute the median. Or <i>percentile</i> (95, <i>score</i>) will return the score corresponding to the 95th percentile.
<i>popStdDev</i>	The standard deviation of the attribute you give it. This is the "population standard deviation."

<i>popVariance</i>	The variance of the values. This is also <i>popStdDev</i> squared.
<i>proportion</i>	Gives the proportion of cases for which the argument is true. For example, if 12 out of 24 people are over 12 years old, <i>proportion(age > 12)</i> will yield 0.5.
<i>Q1</i>	The value that lies at the 25th percentile; for example, the first quartile.
<i>Q3</i>	The value that lies at the 75th percentile; for example, the third quartile.
<i>sampleStdDev</i>	Computes the sample standard deviation according to the formula $\sqrt{\sum \frac{(x - \bar{x})^2}{n - 1}}$. It is an unbiased estimate of the population standard deviation. For example, <i>sampleStdDev(pressure)</i> computes the sample standard deviation of the attribute <i>pressure</i> .
<i>sampleVariance</i>	Computes the square of the sample standard deviation according to the formula $\sum \frac{(x - \bar{x})^2}{n - 1}$. For example, <i>sampleVariance(voltage)</i> computes the sample variance of the attribute <i>voltage</i> .
<i>stdDev</i>	Standard deviation; for example, <i>stdDev(score)</i> . Computes the standard deviation of the cases in the collection using the formula $\sqrt{\sum \frac{(x - \bar{x})^2}{n}}$.
<i>stdError</i>	Returns the standard error; for example, <i>stdError(score)</i> . The formula that is used is $\frac{s}{\sqrt{n}}$ where <i>s</i> is the sample standard deviation and <i>n</i> is the number of cases.
<i>sum</i>	Returns the sum of the values over all the cases. For example, <i>sum(time) count(isNumber(time))</i> is another way to compute the mean of the attribute <i>time</i> .
<i>uniqueValues</i>	The number of unique values that an attribute has in the data set. For example, <i>uniqueValues(sex)</i> will be 2 if there are only two values (“male” and “female”) for <i>sex</i> . (Missing values are ignored.)
<i>variance</i>	Computes the variance of an attribute, that is, the square of the standard deviation, according to the formula $\sum \frac{(x - \bar{x})^2}{n}$. For example, <i>variance(before - after)</i> computes the variance of the difference of the two attributes <i>before</i> and <i>after</i> .

Transformations

<i>bin</i>	Takes the form <i>bin(a, bin, min, max)</i> where <i>a</i> = attribute, <i>bin</i> = bin width, <i>min</i> = start of bin 1, and <i>max</i> = end. <i>bin</i> gives you a string (category value) for <i>a</i> (its “bin” as defined by the other arguments). For example, <i>bin(3.14, 2, 0, 10)</i> gives “b02” because the value (3.14) is in bin 2 in [0, 10] with bins of width 2. (The last two arguments are optional.)
<i>next</i>	The value for the next case. If this is the last case, <i>next</i> returns 0. For example, <i>next(year)</i> returns, for each case, the value of the next year. As with <i>prev</i> , <i>next</i> takes an optional second argument that specifies the value to be returned for the last case.
<i>popZScore</i>	Returns the number of population standard deviations a value is from the mean. For example, <i>popZScore(finalExam)</i> computes a standard score for each value of the attribute <i>finalExam</i> .

<i>prev</i>	The value for the previous case. If this is the first case, <i>prev</i> returns 0. For example, <i>prev(year)</i> returns, for each case, the value of the previous year. An optional second argument allows you to specify the value <i>prev</i> should take if there is no previous case. For example, <i>prev(Factor, 1)</i> will return the previous value of <i>Factor</i> for all cases except the first, for which it returns 1.
<i>rank</i>	Returns the position of the value when cases are ordered from lowest to highest. For example, <i>rank(Population)</i> used as an attribute in a collection of states assigns to each state its rank according to population. Note that if there are duplicate values, the rank will be fractional and the same for all the values. See also <i>uniqueRank</i> .
<i>runLength(flip)</i>	This one's wild! It gives the number of identical values immediately prior to and including the current value. For example, if <i>flip</i> contained {H, H, H, T, H, T, T}, this example would return {1, 2, 3, 1, 1, 1, 2}. You can use <i>max(runLength(flip))</i> to compute the longest streak of heads or tails in a coin-flipping simulation.
<i>sampleZScore</i>	Returns the number of sample standard deviations a value is from the mean. For example, <i>sampleZScore(height)</i> computes a standard score for each value of the attribute <i>height</i> .
<i>uniqueRank</i>	Returns the unique position of a value in a list of values sorted from smallest to largest. Each value in the list gets assigned a different rank, even if there are duplicate values. For example, if the attribute <i>N</i> contains the values {1, 2, 3, 2}, an attribute using the expression <i>uniqueRank(N)</i> will have values {1, 2, 4, 3}. See also <i>rank</i> .
<i>zScore</i>	Same as <i>sampleZScore</i> .

Two Attributes

<i>correlation</i>	Returns the correlation coefficient for two continuous attributes. For example, <i>correlation(stories, height)</i> will return the correlation coefficient for <i>stories</i> and <i>height</i> . This value will be between -1 and +1 and is a measure of how closely the values of one attribute follow those of the other.
<i>covariance</i>	Returns the average of the products of the deviations of each of two attributes from the mean. For example, <i>covariance(hp, mpg)/variance(hp)</i> would give the slope of the least-squares regression line for <i>hp</i> versus <i>mpg</i> .
<i>linRegrIntercept</i>	Returns the intercept of the least-squares regression line with <i>x</i> as the independent attribute and <i>y</i> as the dependent attribute.
<i>linRegrSlope</i>	Returns the slope of the least-squares regression line with <i>x</i> as the independent attribute and <i>y</i> as the dependent attribute.
<i>rSquared</i>	The square of the correlation coefficient for two attributes. <i>rsquared(x, y)</i> represents the proportion of the variation of <i>y</i> that is accounted for by the variation in <i>x</i> . It takes on values between 0 and 1.

Expressing Qualifiers in Statistics Functions

<i>caseIndex</i>	A value equivalent to the “row number.” No parentheses are needed. This is the order in the collection, not the order you see in a sorted case table.
<i>false</i>	A constant whose value is always false.
π	You can enter the value for π by typing pi or by double-clicking the entry for pi under Special in the function list.
<i>true</i>	A constant whose value is always true.

In the Menus

Here is a list of the TinkerPlots menus and what is in them. If a command is followed by “(Win),” it appears in another menu on the Macintosh (and vice versa.) If a command is followed by “(Win only),” it is not available on the Macintosh. Some commands have keyboard shortcuts, which can be found beside the command in the menu. You can find additional useful shortcuts in [Keyboard Shortcuts](#).

Most objects also have a contextual menu, containing commands you might need while working with that object. To access these menus, select the object and right-click (Win) or press **Control** and click (Mac).

TinkerPlots (Macintosh only)

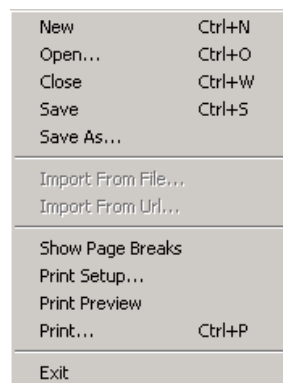
Use the **TinkerPlots** menu to hide or quit TinkerPlots and to set preferences. Some commands in this menu are available in other menus in Windows, as noted.



About TinkerPlots	Displays basic information about TinkerPlots, including the version you are using. (In Windows, this is in the Help menu.)
Preferences	Allows you to use large fonts in TinkerPlots objects and to turn sound off. (In Windows, this is in the Edit menu.)
Services	Allows you to choose from other Macintosh services.
Hide TinkerPlots	Removes TinkerPlots from your screen without closing it.
Hide Others	Removes all open applications except TinkerPlots from your screen without closing them.
Show All	Shows all open applications and windows.
Quit TinkerPlots	Quits the program. (In Windows, this is in the File menu.)

File

Use the **File** menu to open, import, save, and print files. This is how the **File** menu appears in Windows:



New	Brings up a new, blank TinkerPlots document.
Open	Opens an existing TinkerPlots document.
Close	Closes the current document. This is the same as clicking the close box on the window. If the document has not been saved, TinkerPlots prompts you to save it.
Save	Saves the document. If it has been saved before, TinkerPlots updates the file to the current state. If the document hasn't been saved before, TinkerPlots asks you to give it a name and specify where to save it.
Save As	Saves the document, but allows you to give it a new name and specify where to save it (thus preserving the previously saved file).
Import From File	Imports data from a text file. You enter the name of the file in the dialog box that appears.
Import From Url	Imports data from the Internet. You enter the URL, and TinkerPlots imports the data.
Print Setup (Win) Page Setup (Mac)	Chooses a printer, page size, and so forth.
Show Page Breaks	Shows where page breaks will occur when the document is printed. This is useful if you want everything to appear on one page, for instance.
Print Preview (Win only)	Shows what your document will look like printed.
Print	Prints your document. In the dialog box you say how many copies you want, the page numbers to print, and so forth.
Exit (Win)	Quits the program. (On the Macintosh, this is in the TinkerPlots menu.)

Edit

The **Edit** menu controls the clipboard, undoing, editing, and preferences. The specific names of some menu items change to reflect the object selected. This is how the **Edit** menu appears on the Macintosh:

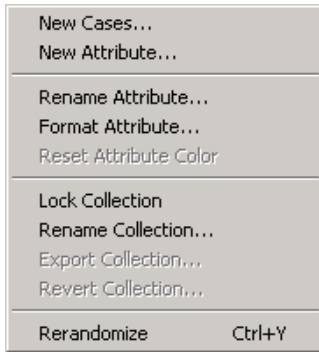
Undo New Data Cards	⌘Z
Can't Redo	⌘R
Cut	⌘X
Copy	⌘C
Paste	⌘V
Delete	
Select All	⌘A
Delete Object	⌘⌫
Hide Object	
Show Hidden Objects	
Duplicate Object	⌘D
Edit Formula	⌘E
Cut Formula	
Copy Formula	
Paste Formula	
Clear Formula	

Undo (Action)	Undoes the last thing you did. The menu name shows the last action (such as Undo Typing). TinkerPlots has unlimited undo.
Redo (Action)	Redoes the last action you undid.

Cut Case or Cut Attribute or Cut Text	Cuts what is selected and puts it on the clipboard. You can cut text from text boxes, data cards, or case tables. You can also cut cases or attributes from data cards or case tables.
Copy	Places a copy of what you've selected into the clipboard. If you select and copy an object (such as a plot or case table), TinkerPlots copies it as a picture . This is one way to take a snapshot of a graph to put into another application.
Paste	Pastes what is on the clipboard into the location you have selected. If the clipboard contains text, Paste replaces selected text or inserts the text at the insertion point. If the clipboard contains cases, Paste adds those cases to the selected stack of data cards.
Delete Case or Delete Attribute or Delete Text	Deletes the case, attribute, or text you have selected.
Select All	Selects all cases in a stack of data cards or case table; selects all text in a text box.
Delete (Object)	Deletes the selected object. Use this to eliminate unwanted objects such as data cards, plots, text boxes, and so forth.
Hide (Object)	Hides the selected object from view. It does not eliminate any of the selected objects from the document.
Show Hidden Objects	Unhides any hidden objects in the document.
Duplicate (Object)	Makes an exact copy of the selected object and places it in the document. This is especially useful for making a duplicate of a plot .
Edit Formula	Brings up the formula editor for the selected attribute (same as double-clicking in the attribute's formula cell in a data card or case table).
Cut Formula	Cuts the formula from the selected attribute in the data card or case table.
Copy Formula	Copies the formula of the selected attribute in the data card or case table and places the formula in the clipboard.
Paste Formula	Pastes the formula in the clipboard into the selected attribute. This is perfect for avoiding retyping a complex formula: copy it from one attribute and paste it into another.
Clear Formula	Removes the formula from the selected attribute. The values of the attribute will remain, but they will now be the same as if you'd entered them individually without a formula.
Preferences (Win)	Allows you to use large fonts in TinkerPlots objects and to turn sound off. (On the Macintosh, this is in the TinkerPlots menu.)

Data

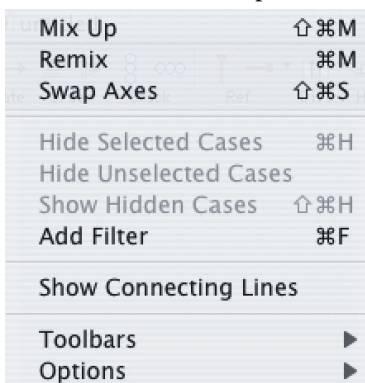
The **Data** menu controls new cases, renaming attributes, and locking a dataset to prevent it from being changed. This is how the **Data** menu appears in Windows:



New Cases	Adds new cases to your data set. You specify how many.
New Attribute	Adds a new attribute to your data set. If an attribute is selected in a case table, the new attribute is placed to the left of the one selected.
Rename Attribute	Changes an attribute's name (same as double-clicking its name).
Format Attribute	Changes how numbers are formatted into scientific or engineering notation. You specify the number of significant digits displayed.
Reset Attribute Color	If you have changed the color scheme of one or more attributes in the data cards, this restores the original attribute colors.
Lock/Unlock Collection	Locks the collection to prevent changes to the data. You can still analyze the data, but you can't edit values, add new cases, make new attributes, rename them, and so forth. Unlock to allow changes to the data.
Rename Collection	Allows you to change a collection's name (same as double-clicking its name).
Export Collection	Exports data from the selected stack of data cards to a tab-delimited text file.
Revert Collection	Restores the data in the selected stack of data cards to how they were when you last saved. If you've changed one or more data values, this is a quick way to undo these changes. This does not delete or change plots or other objects you may have added.
Rerandomize	Generates new random values for values created using a random function .

Plot

The **Plot** menu controls axes, filters, hides cases, and lets you customize the plot toolbars. To see the **Plot** menu, select a plot. This is how the **Plot** menu appears on the Macintosh:



Mix Up	Returns a plot to its original, disorganized state. This is the same as pressing the Mix-up button on the lower plot toolbar.
Remix	Remixes unstacked cases within a bin.
Swap Axes	Swaps the attributes on the horizontal and vertical axes. If only one attribute is plotted, it will move to the other axis.
Hide Selected Cases	Hides cases that are selected in the plot.
Hide Unselected Cases	Hides cases that are not selected in the plot.
Show Hidden Cases	Unhides any cases that are hidden in the plot.
Add Filter	Adds a filter to the plot . If there is no current filter formula, the formula editor will appear. You enter a formula that specifies the cases to keep in the plot.
Show Connecting Lines	Connects the cases in a plot with a line according to case order . This is useful with graphs of data that were entered according to time or in some other particular order .
Toolbars	Allows you to remove the upper or lower plot toolbars entirely or to remove particular buttons from the toolbars.
Options	Allows you to show/hide attribute units , change bin styles , modify the Drag Value tool , and stack by case order .

Text

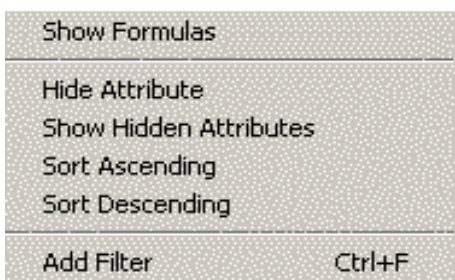
The **Text** menu controls font, size, and style of text in a text box. To see the **Text** menu, select a text box.



Text Font	Specify font for selected text.
Text Size	Specify font sizes for selected text.
Text Style	Specify style (plain, bold, italic, underline) for selected text.
Show Text Palette	Brings up a text palette for setting font, size, style and for inserting special symbols and characters. In Windows, the palette appears docked at the bottom of the screen; on the Macintosh, it floats.

Table

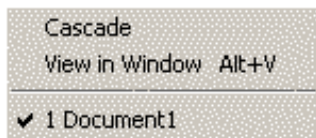
The **Table** menu controls attribute and formula display, sorts the data in the table, and adds filters to case tables. To see the **Table** menu, select a case table. This is how the **Table** menu appears in Windows:



Show Formulas	Displays attribute formula row for viewing and editing of attribute formulas .
Hide Attribute	Hides the selected columns (attributes). The attributes will still appear in the data cards.
Show Hidden Attributes	Unhides any hidden attribute in a case table.
Sort Ascending	Sorts cases in case table in ascending order of selected attribute from smallest to largest.
Sort Descending	Sorts cases in case table in descending order of selected attribute from largest to smallest.
Add Filter	Adds a filter to the case table . If there is no current filter formula, the formula editor will appear. You enter a formula that specifies the cases to keep in the case table.

Window

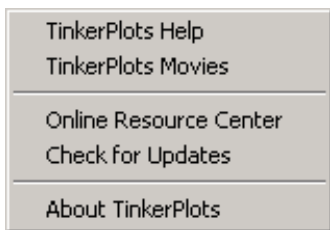
Use the **Window** menu to choose among the current windows and to open objects in a floating window. This is how the **Window** menu appears in Windows:



Cascade (Win only)	Lays out the windows so that you can see all their title bars.
View In Window (names)	Opens the selected object in its own floating window. Select the open TinkerPlots document that you want to bring to the top.

Help

Use the **Help** menu to find out how to accomplish particular tasks in TinkerPlots, to access tutorial movies, and to access online resources. This is how the **Help** menu appears in Windows:



TinkerPlots Help	Brings up the TinkerPlots Help system in your browser (but does not connect you to the Internet).
TinkerPlots Movies	Allows you to access movies giving instruction about various features of TinkerPlots. This opens your browser but does not connect you to the Internet.
Online Resource Center	Takes you to a Web site where you can get more data sets and activities, share your own data, and get other resources.
Check for Updates	Takes you to a Web site where you can check if you have the most recent version of TinkerPlots, and download an update if not.
About TinkerPlots (Win)	Displays basic information about TinkerPlots, including the version you are using. (On the Macintosh, this is in the TinkerPlots menu.)

Keyboard Shortcuts

Keyboard shortcuts for menu commands are listed to the command in the menu. Here are additional useful keyboard shortcuts:

Operating on Data in Plots

Action	Windows	Macintosh
Increase icon size	+	+
Decrease icon size	-	-
Slow animation	Space	Space
Order descending	Shift+Order Vertical/Horizontal	Shift+Order Vertical/Horizontal
Use Drag Value/Add Case/Drawing Tool multiple times	Alt+tool	Option+tool
Reposition cases while an attribute is selected	Press Alt while dragging case icons.	Press Option while dragging case icons.

Moving Around in Data Cards and Case Tables

Action	Windows	Macintosh
Go to first case	Home	Home
Go to last case	End	End
Go to next case	Page Down	Page Down
Go to previous case	Page Up	Page Up
Move to next value/cell	Tab	Tab
Move to previous value/cell	Shift+Tab	Shift+Tab

For [Fathom](#) Users: Show Fathom Collection Object

1. Press and hold **Ctrl+Alt** (Win) **Command+Option** (Mac). Macintosh users can also click anywhere in the document.
2. Click in a blank area in the document (required on Mac only).
3. From the **Edit** menu, choose **Show Hidden Objects**.

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